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Functional Content for General Science

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VOLUME 27

NUMBER 1

FEBRUARY 1943

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Devoted to the Teaching of Science in Elementary Schools, Junior and Senior High Schools, Colleges and Teacher Training Institutions

Volume 27 **FEBRUARY, 1943** **Number 1**

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PUBLISHED BY

SCIENCE EDUCATION, INCORPORATED

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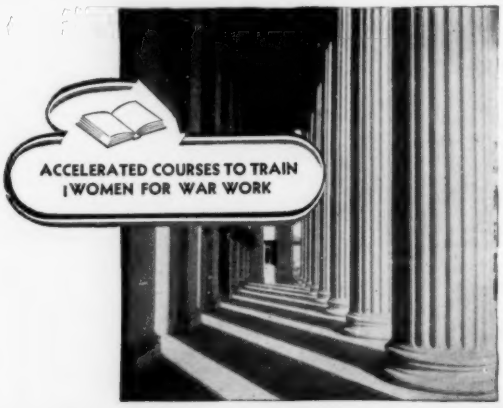

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Science Education

COMPETENCY IN SCIENCE TEACHING—NOT CREDIT HOURS—I *

G. P. Cahoon

Ohio State University

In many respects, teachers and teaching have not kept pace with developments in other phases of our rapidly growing and constantly changing public school system. Our modern schools are, in general, quite adequately equipped. We have excellent textbooks and a wealth of supplementary materials. Nearly all schools make use of such modern devices as laboratories, shops, motion picture projectors, radios and playground apparatus. We provide bands, home economics courses, medical services, auditoriums, guidance programs, cafeterias, and uniforms for athletic teams. Why shouldn't pupils get the experiences and information they need and come out of such an "educational machine" adequately prepared "in the basic aspects of living in such way as to promote the fullest possible realization of personal potentialities and the most effective participation in a democratic society"?

No educational scheme or device is automatic—or even semi-automatic. Pupils cannot be put into the hopper of an educational power machine along with any possible combination of hour periods, pupil projects, visual aids, recordings, core courses, text and workbooks, teacher-pupil planning, field trips, laboratory experiments, objective-type tests, and movable chairs and tables—and come out at the end of a six-year exposure as the finished products we'd like to have them be. These various devices and methods are, of course, essential material and tools for providing the activities appropriate for achieving our goals. But teachers are necessary to plan what are appropriate experiences for all the needs and interests of our unselected secondary school population, and to arrange and shift the devices and procedures and materials as progress is made toward the goals. The entire school is set up (theoretically) so as to facilitate and make most functional this process of teacher-pupil relationships in providing experiences.

A teacher in a school concerned with providing experiences for pupils to achieve modern goals, needs to have a competency which is almost as complex and varied as the nature and activities of life itself. But teachers have numerous limitations in this connection, which probably do not need to be recited here. Their preparation has not been adequate for them to achieve the competency essential for providing needed pupil experiences in the modern school.

SOME REASONS WHY BEGINNING TEACHERS HAVE LIMITATIONS

Apparently the psychology of individual differences does not apply to college students preparing to be teachers. We start everyone out at the same starting line in a sort of four-year cross-country run with the lanes all marked off. Each has to go the same distance, by the same route, and in the same length of time. About all one really has to do is to take the required courses and amass the appropriate number of credit hours to be certified to teach. To pass the courses one needs to be able to

* President's address at the meeting of the National Association for Research in Science Teaching, Cleveland, Ohio, February, 1942.

retain certain information from books and teachers' lectures long enough to give this back on examination day. For four years we keep prospective teachers severely away from boys and girls and from teaching situations, and from contact with community problems, and have them read books and write papers and listen to lectures.—And then we expect them after a few weeks of "practice teaching," which is often largely observation, to go out to guide young people to develop personality and to become intelligent citizens. We do not set up for these prospective teachers any hurdles concerning information, values, personality, health, ability to do things—to express themselves, to work with children and with adults in the community, to initiate, to make things, to think, to stimulate, to be able to locate and use sources and practical devices and applications—we only ask "how much time have put put in?".

Many, if not most, of the science courses which prospective teachers "take" are background courses for more advanced work in the field, often on the assumption that students are or might go on to be research workers. The goals of such courses are usually almost entirely concerned with achievement of information. The techniques and student experiences are confined to textbook, lecture, follow-the-laboratory-manual, and written and oral quizzes. The instructor feels little responsibility or need for making the course interesting in most cases, or of providing experiences or procedures designed for helping the student to think, or to develop various personality traits, or to work together with other people. Usually he has no particular need for directed study techniques, for using supplementary materials such as popular or even technical magazines, government publications, nor even of visual or audio aids. Usually he leaves it to the student to apply the theories and generalizations to any practical situations.

Thus, since students are prone to "teacher as they were taught," they tend to continue this type of teaching and to provide similar experiences and to have similar attitudes toward junior and senior high school pupils, when the needs of such pupils and the goals are quite different.

Science subject matter courses, even in so-called "teachers' colleges" usually are not professionalized. This is often particularly true with respect to the use of laboratory apparatus and practical devices. Students see a few demonstrations—performed by the teacher; and even when they go into the laboratory they simply ask for the equipment for experiment No. 17 and it is checked out to them in a kit to be assembled. The glass tubing is already cut to the right length, connection-lugs have been soldered to the wires, a meter with an appropriate range has been provided—everything needed is there and in good working order. All you have to do is fit the parts together, push the buttons, and record the readings in the columns prepared for you on the record sheet.

Much of the spare time of these prospective teachers in college is given over to jobs for earning their board and room, where they get little contact with devices or techniques valuable in science teaching. They are doing the jobs simply to enable them to stay around long enough to "take" the necessary courses so as to accumulate the required number of credit hours. Thus most prospective teachers get little experience in using practical laboratory devices and techniques either in their science courses, or in their out-of-school jobs.

Professional courses in education have not served to lessen these limitations in most cases, but rather to widen them. We lecture to prospective teachers and have them read about ideas and concepts and techniques, when they have no background of experience with what it is all about. We talk about democracy and motivation, about character and guidance, pupil-teacher planning, social sensitivity, the whole child—about units, evaluation instruments, work periods, visual aids, projects—but it is all

vague and meaningless theory to most prospective teachers who have not yet come up against the problems of teaching boys and girls. It is much like trying to give a lecture to teach a person to skate or to swim.

WHAT NEEDS TO BE DONE

Why should we expect prospective teachers to be competent or proficient in doing jobs in which they have had no experiences? When the only hurdles which we set up are hurdles with reference to time-puting-in and credit-getting, we ought not to expect that the skills which enabled them to leap these will also carry them over others of a quite different type.

Of course, teaching is complex. But is it so complex that we cannot indicate some of the specifics in which teachers should be proficient and give them some experiences with these—and expect them to come up to certain standards?

Courses are merely means to ends. But we treat them as if they were the very important ends themselves. "You can't graduate or be certificated if you haven't credit for this and this course"—we say to prospective teachers. What difference does it make what courses teachers have had if they cannot do or be what a teacher needs to do or be? Or what difference does it make what courses teachers have not had if they can do or are what good teachers should be like?

Why shouldn't we be able to say that these are the skills, a good proportion of which a prospective teacher should be able to exhibit; this is the information, the majority of which he should have; these are the sources and techniques with which he should be generally familiar. And then why shouldn't we set up some sorts of evaluation to get evidence as to whether he is competent in these respects? How he gets them is really not important as an end-product, or at least it is another question —does he, in general, have them?

WHAT AN EMPHASIS ON COMPETENCY MIGHT MEAN

Why shouldn't courses be, then, the service agencies to which one goes to get guidance and experience in obtaining the skills and information requisite for certain competencies? There would need to be evidence of whether one jumped the competency hurdles with which the course was concerned. There would really be some purpose to courses then—and students would probably see to it that instructors stuck to the purposes so that they could get the experiences and skills needed for providing growing evidence of appropriate competency.

There would then need to be not only different types of courses but other kinds of experiences for prospective teaching in order to obtain the necessary competencies. And they wouldn't, of course, be the same for all teachers-to-be. Why do we preach about individual differences and the need for different "treatment" and experiences for high school pupils to these prospective teachers, and then treat all of them as if they were alike? Begining teachers have as great and as numerous variations as do junior high school pupils, and the teacher preparation program should recognize and make appropriate provisions for these. Some prospective teachers would need further (and different) experiences in written expression; some in speaking; some in working with people; some in seeing "how the other half" lives; some in physical exercise; some in certain kinds of manual skills and practical experience; some in knowledge and information in particular fields. The amount of time put in on these would not be the same for all—nor would it be the only criterion by which the value of the experience would be judged.

This would almost inevitably mean that all prospective teachers would not put in the same total amount of time. Some might be able to give satisfactory evidence of competency in three years or less—many

would probably have to take five years or more. Again the total amount of time "served," as in a penal institution for some crime, would not be the sole criterion for their "release" and the award of a teaching certificate.

Of course, the achieving or failure in one or two or any given number of competency hurdles would not allow or disallow a person to be certificated for teaching. The total situation—the "whole teacher"—would have to be considered. Sometimes a preparing teacher would be "passed" when his proficiency in a particular hurdle was weak, because of compensating proficiencies in other hurdles. At other times a teacher even more proficient in this same hurdle might be held back in consideration of his total strengths and weaknesses.

Why shouldn't we be more concerned with the ends toward which we are striving in preparing teachers? They are the ones who are going to bring about the kind of schools and pupil outcomes and citizens we preach about and strive for. What kind of competencies do teachers need in order to achieve these goals? These are the ends with which we surely need to be concerned. But we should be no less concerned with means. We need to be concerned that the means being provided are really the most effective ways of making the most rapid progress toward achieving the desired ends. We need to make more specific and clear-cut the ends—the teaching competencies; and then devise for prospective teachers really appropriate means—the experiences, both in and out of courses. We need to have frequent check-ups to determine whether the means being provided are actually producing the competency for which we are striving. We need to do less hoping that merely putting prospective teachers in courses concerned largely with information —about things or about children or about teaching—will result in abilities and skills in dealing with children and teaching. We need to do less hoping and get more evidence of whether the abilities and phases in competency are actually being attained; if they are (my "scientific attitude" would of course suggest that such an hypothesis be included as a possibility)—if such abilities in competency are being satisfactorily attained, then we may assume that the courses, or the adaptability, or the native ability, or the previous experiences, or something now possessed or provided, is satisfactorily bringing about such abilities. But if such competency is not being achieved, then we need to examine the means which we are providing and make some modifications, and continually check and re-check, and modify some more, as the kind of competency changes, the kind of prospective teachers change, and different types of means become available.

A SUGGESTED PROGRAM FOR SCIENCE TEACHERS

Perhaps this sounds like vague theory; how would you actually do it in a teacher-preparing institution? Of course there would be no one pattern that could or should be followed in all institutions to provide competent science teachers—any more than we advocate a prescribed blueprint for all science teachers in working with boys and girls in secondary schools. An approach for putting into practice such a proposal as we have been advocating may be suggested. The main features of this would include:

1. Setting up factors in teaching competency—for all teachers.
2. Devising ways for getting evidence of the various factors in competency.
3. Providing appropriate experiences for prospective teachers.
4. Setting hurdles at various stages.
5. Determining phases, evidences of and experiences for competency in specific areas (as science).

SETTING UP FACTORS IN TEACHING COMPETENCY

The factors in competency for teaching are the ends toward which we are striving —we need to set them up carefully. And it is a big job, particularly when we've been

concerned so long with merely providing courses and figuring out what would be "good for" prospective teachers to know or contact in these courses. It is difficult to focus attention on the kind of product we really are, or should be, concerned about. One such statement [1] of factors in competency is the result of four or five years' deliberation by a group at one institution who tackled this problem. It has gone through five or six revisions and is not entirely satisfactory yet to even the committee which worked on them, much less to numerous individuals. But it does represent a concerted attempt in attacking this problem of providing direction and a guide for the program for beginning teachers. Each teacher-preparing institution probably will have to set up its own statement of factors in competency in accordance with its own philosophy and the nature and needs of the particular situation.

GETTING EVIDENCE OF THE FACTORS IN COMPETENCY

Course grades, point-hour ratios, credit hours, may provide some evidence with reference to some competencies, but they need to be supplemented with a great many different kinds of evidence specifically related to the various factors. For many of the factors with which we are concerned there are already available quite valid and reliable instruments and techniques, once we know what kinds of outcomes we want. Some are quite simple and provide easily attainable data, others are more complex.

It would seem clear that it is desirable if not essential to know a great deal about each student and to have a continuing personnel program with a cumulative record of progress toward factors in competency with related experiences and activities. If students are to be guided so as to get the experiences appropriate to their individual needs with reference to these factors in competency, we must early have data about them so as to plan accordingly. To find out, as so often has happened, only during the student teaching experience that a prospective teacher can't speak well, or is socially unadjusted, or has no understanding of children, is too late to give effective guidance to obtain experiences necessary to achieve satisfactory competency in these respects. So we usually give them a passing mark and allow them to go out to teach, hoping that they'll outgrow their deficiencies.

A good deal of evidence will have to be obtained during the lower and upper division programs before the student teaching experience. Among the problems relative to certain factors in competency about which evidence can be obtained during the lower division program would be: (1) the speaking voice; (2) emotional problems; (3) physical handicaps; (4) study and work habits and skills; (5) health; (6) writing skills; (7) ability to plan for goals and needs; (8) social adjustment; (9) knowledge of communities; (10) general cultural information and background.

For most of these factors there are quite suitable evaluation instruments or techniques available. For some, such as "knowledge of communities" and "general cultural information," tests or other evaluation instruments would have to be devised especially for particular local situations. A good deal of evidence with reference to many of these could be obtained from "anecdotal records" of instructors, if one could get them to provide these.

Evidence of most of the other factors in competency could be obtained in the upper division program—along with further evidence of those started in the lower division, of course. Some of these we previously just assumed that prospective teachers got by getting credit for certain courses. This is true particularly of functional knowledge in one or more major areas, as science, and

[1] *Some Major Factors in Competency for Teaching.* College of Education, Ohio State University; May, 1941 (Mimeographed).

of a variety of professional information and skills such as understanding the growth and development of children, the psychology of learning, and the ability to construct evaluation instruments for particular outcomes.

Why do we assume that prospective teachers, have adequate knowledge about, and only few misconceptions concerning such important factors in competency—not to mention abilities in putting them into practice? Do we have such obvious evidence to this effect? We might at least use or devise some evaluation instruments to be sure that our assumption was valid.

Factors in competency about which evidence could be obtained during the upper divsion program might include: (1) educational philosophy and values; (2) understanding and applying principles of child development; (3) familiarity with and ability to use the resources of the library and of community and national agencies, institutions, and companies; (4) ability to plan teaching material for a variety of goals; (5) understanding and providing for individual differences; (6) construction of evaluation instruments for particular outcomes; (7) skill in constructing and using visual and audio aids; (8) familiarity with a wide range of teaching techniques; (9) ability to use reflective thinking; (10) knowledge and skill in major subject fields.

(Continued in March issue)

SCIENCE INSTRUCTION IN SCHOOLS OF THE SOUTHERN ASSOCIATION STUDY IN SECONDARY SCHOOLS AND COLLEGES *

EUGENE A. WATERS

University of Tennessee

Regional, cooperative studies, undertaken by several schools and assisted by grants-in-aid from foundations, represent one type of organized attempt to improve the programs of our secondary schools. These cooperative studies have been especially numerous during the past ten years, and have been directed toward the development of a more functional type of school. Practically all of these studies have professed an interest in the needs of youth and in the development of educational programs which would better serve youth and adults in their day-by-day living. The Southern Association Study in Secondary Schools and Colleges is one of these cooperative studies and has special reference to the improvement of secondary education in the southern states.

* Read at Cleveland meeting of the National Association For Research in Science Teaching, February, 1942.

The work of science teachers in the Southern Association Study cannot be reported adequately in isolation from the work of other teachers engaged in the Study. A general description of the Study as a whole seems necessary as an orientation to some of the problems faced by science teachers in the schools taking part in the Study. The purpose of the Study, the procedures used to accomplish this purpose, and the character of the schools and their communities must necessarily be understood in order to understand and appraise the part of the science teachers in the work of the Study.

Hence, it seems appropriate to include in this report an account of the general purpose and procedures used in the Study, and some background description of the schools and communities which are taking part in this cooperative enterprise.

The history of educational associations

in the South is marked by continuous efforts to extend and improve educational opportunities and services. The Southern Association of Colleges and Secondary Schools has, since its organziation, given consideration to the improvement in the quality of school and instructional procedures. The work of this Association shows a gradual shift of emphasis from approving and accrediting secondary schools and colleges to direct aid to those engaged in attempts to improve their educational programs. This gradual shift in emphasis influenced the creation, in 1935, of a new Commission in the Association, the Commission on Curricular Problems and Research.[1] It is this Commission which initiated the cooperative study which has been called The Southern Association Study in Secondary Schools and Colleges. The Study has included in its activities work with elementary schools, secondary schools, colleges, and universities.

During its organization meetings, the Commission on Curricular Problems and Research first considered the type of study most likely to achieve improvement of education in the South. Serious consideration was given to a proposal to conduct a study in which experimental schools would be matched with control schools. However, as a result of Commission discussion, it was decided to conduct, not one study, but a number of studies in selected schools in the South, each focused on building an educational program which would better meet the needs of youth in the particular community served by the school concerned. The rejection of the proposal to attempt a "controlled" experiment and the decision to engage in a series of studies in several secondary schools marks the initial acceptance of one of the fundamental assumptions underlying procedures used in the Study; namely, that the most effective way to bring about educational improvement is for the individual school to plan its program in terms of its own needs and the nature of its community.

As a result of an early meeting of the Commission on Curricular Problems and Research, suggestions for such a study were prepared and presented to the Commission during the annual meeting of the Southern Association in Richmond, Virginia, December 2, 1936. The nature of the proposal, as later adopted by the Commission, is indicated by the following quotation from the Commission's report:

"Proposal 1: Cooperative Study between High Schools and Colleges designed to Develop an Educational Program that will more adequately meet the needs of our adolescent Group.

"It is the purpose of the Commission on Curricular Problems and Research of the Southern Association of Colleges and Secondary Schools to plan and direct a cooperative study on the part of both high schools and colleges designed to develop an educational program that will more adequately meet the needs of our adolescent group.

"In attacking this problem selected secondary schools and colleges will be encouraged to modify their present instructional programs in such manner as will provide for desirable outcomes not now being achieved by our schools.

"In order to accomplish this purpose the selected schools should be left free to depart from traditional practices where such departure seems desirable. It will probably require that provision be made whereby graduates from these schools may be admitted to higher institutions without the usual restrictions.

"It is suggested that each State Committee as above indicated canvass the secondary schools in their state for the purpose of selecting a tentative list of schools which, in the mind of the committee, are qualified to enter into the cooperative study. The school thus selected will be given an opportunity to present in detail programs which they would like to undertake.

"In the prosecution of these studies, it is not the intent of this Commission to restrict or discourage sound experimentation on the part of other secondary schools in the Association." [2]

By the end of the school year 1937-1938 selection of thirty-three schools, three from each of the eleven southern states, had been

[1] *The Southern Association Study*, Jenkins, F. C., and Staff. The Commission on Curricular Problems and Research of the Southern Association of Colleges and Secondary Schools, Nashville, Tennessee. P. 1, 1941.

[2] *The Southern Association Quarterly*, Vol. I, No. 1, February, 1937, pp. 138–39.

completed. The thirty-three schools are all member schools of the Southern Association of Colleges and Secondary Schools. They range in size from fifty-five to two thousand students. Approximately one-half of the schools are located in rural areas or draw a large part of their students from rural communities. Collectively, they represent a fairly adequate sampling of schools in the South and their communities reflect the social and economic problems that characterize southern communities. The descriptions of the schools, prepared by the schools upon their entrance into the Study, may be found in *The Southern Association Study, op. cit.*, on pages 5 to 9. These descriptions of the schools and communities cooperating in the Study emphasize their diversity in size, economic structure, and social character. It seems evident that no single pattern of school program would serve the needs of each community equally well.

Further, as the faculty of each school undertook to modify their instructional programs in such manner as would provide for desirable outcomes not being achieved by their school, variations in the resultant programs and in their instructional procedures were to be expected. In accordance with the original intent of the Commission, final decisions concerning changes to be made in the several schools were left to the schools themselves. In fact, as a preliminary to entrance into the Study, each school faculty had made such decisions during the preparation of the statement of plans for improving its school program.

The Commission's work with these schools has been carried on through summer conferences, staff work in the schools during the school year, local conferences conducted by school faculties in their own schools and communities, conferences of representatives of school faculties within a region, and through conferences or workshops conducted by colleges and universities in cooperation with the schools and the staff of the Study.

The concept of the role of the staff, that has been accepted throughout the Study, in its work with teachers and principals is indicated by the minutes of staff meetings held prior to the beginning of the first Summer Conference. An examination of these minutes show that there was agreement upon the following procedures and points of view:

"A planning committee, composed of teachers, principals, and staff members was given the responsibility of carrying out the wishes of the Conference participants. It was to be concerned with the arrangement of group meetings, adjustment in living conditions, provisions for recreational activities, and suggestions for the improvement of all Conference procedures.

"Devices were to be provided by means of which the wishes, concerns, and suggestions of individual participants would be brought to the attention of the planning committee for its consideration.

"Daily scheduling procedures which were directly controlled by the stated desires of individual participants would be used.

"The individual staff member's background of experience and specialization would be used in furthering the study or studies proposed by the participants, rather than in directly determining what the participants would study."[3]

The typical school group in attendance at summer and regional conferences has been composed of the high school principal or superintendent and three or more teachers. Throughout the Study the school administrator has worked as a member of his school group in summer conferences, local studies, and in staff and committee work carried on in the schools during the school year. The advantages of this procedure has been especially evident in the improvements in cooperative relationships of administration and faculty within schools and in the increased concern evidenced by principals and superintendents for the improvement of their school programs.

From this background the practices which have characterized the work of science teachers in the schools is more under-

[3] *Op. cit.*, p. 12.

standable. Each science teacher who has participated in the Study has proceeded, as a member of his faculty, to introduce such content, materials, and teaching practices as would, in his judgment and in the judgment of his colleagues, improve his work and the program of the school in which he taught. He did not proceed in isolation from the rest of the faculty of the school but as one member of a group engaged in a cooperative attempt to better the total design of the school program. It would be expected, then, that no single pattern of the science curriculum or of instructional practices in science would be likely to emerge from the setting, purpose, assumptions, and procedures underlying the Study.

It is not possible, within the limits of the paper, to discuss the specific alterations in subject-matter, instructional procedures, scheduling, and evaluations made by each science teacher engaged in the Study. Indeed, to do so might over-emphasize terminal results of procedures used by the teachers at the expense of making the procedures themselves clear. It is probably more appropriate, therefore, to confine the remainder of this report to a consideration of the manner in which the science teachers have sought to improve their teaching and the total program of their schools.

One of the first undertakings of many teachers engaged in the Study was that of making a careful appraisal of the helps which the school could and should give to its pupils and to its patrons in the community. In so-for-as the discovered needs of pupils was concerned, these appraisals did not, in general, yield results that are at all new to those engaged in education. For example, it was found that a number of the pupils were planning to attend college, to enter vocations, to quit school, and it was found that many had no definite plans at all. The appraisals also revealed that some children were under-nourished, some were insecure, others were poorly clothed, and others were handicapped by disease. The findings, together with the pupil needs inferred from them, are closely similar to those frequently enumerated by educational groups.

As a result of these appraisals many teachers and groups have proposed ways the school could give needed helps to the pupils and to the community. For example, proposals for bettering the science preparation of pupils who planned to enter college included, "improved command of subject matter, more direct emphasis upon the pupil's use of the method of science in his study, more emphasis upon developing effective habits of study and less dependence upon detailed direction, and more continuous contact with problems related to the field of science." Again, proposals for improving the general health of pupils in some of the schools included "health examinations for all children," "provision of medical treatment in cases of discovered need," "provision of more adequate recreational facilities in the community," "development of an improved physical education program," and "improvement in the economic status of families in the school community." *

Such proposals were easily arrived at, but finding practical ways to incorporate them into the school program, and to achieve the ends sought through the proposals, has proved a more difficult problem. The nature of the plans evolved for changing instructional procedures and often the entire school program so as to achieve ends such as the above have meant that the teachers have encountered, and continue to encounter, difficulty in carrying them out. This is especially true of those proposals which have to do with improving economic and social aspects of life in the schools and its community. These are problems not usually undertaken by teachers, except through the most indirect means.

Throughout the work of the Study, the

* The quoted statements are those made by science teachers and are taken from minutes of group meetings and from proposals made by science departments in schools of the Study.

Commission on Curricular Problems and Research has provided assistance to the teachers which was calculated as a direct means of arriving at practical ways of translating the teachers' proposals into programs of action. This assistance has assumed the form of the staff work in the schools, summer conferences of teachers and administrators, local conferences conducted by schools in their own communities, conferences and workshops conducted by colleges and universities in cooperation with the Study, and regional conference of teachers who were undertaking closely similar problems.[4]

Within the scope of this report it is not possible to include an adequate description of the means which teachers in the Study have developed to implement their proposals for the improvement of their school programs. It is possible to classify, somewhat roughly, the revisions which have been introduced into the programs of the thirty-three schools in terms of changes in instructional procedures, evaluation procedures, administrative procedures; relationships among pupils, teachers, and parents; and contributions to the betterment of community life.

As science teachers, we have repeatedly stated that our teaching and subject-matter should function in the daily life of individuals and communities. We have not always been equally clear on how this could be done. Consequently, it seems appropriate to indicate here some of the ways teachers in the Southern Study have attempted improvement in the recreational opportunities, health conditions, and in the economic status characterizing their schools and communities. It should be pointed out that this emphasis upon one aspect of the schools' evolving programs does not imply that the other problems and concerns of the youth touched by the schools in the Study have been neglected.

[4] For a more complete description of these services, see *The Southern Association Study, op. cit.*, pp. 11–49.

The illustrations, cited below, outline some of the work undertaken by teachers and pupils in the Southern Study Schools, as a consequence of their consideration of the problem of bettering the life of those served by the school. These procedures are among those which have been directed toward improvement of the social and economic factors operative in some schools and communities engaged in the Study.

"1. Because of a consideration of health needs in the community, a number of activities have been set up through the cooperative work of teachers and pupils. The following are typical projects resulting from such study: (a) every school child was examined for intestinal parasites, and treatment was given to those found infested; (b) children of families receiving any aid from the federal government were given dental examinations, and necessary dental work was done; (c) our school helped to organized a parish society for crippled children. This organization, through the cooperation of pupils and teachers, cited cases of disability. These were brought to a parish clinic, or were taken to New Orleans where they received the attention of a specialist; (d) every child suspected of having tuberculosis was given a test and, if this was positive, further observation and treatment was provided; (e) about 30,000 free lunches were served to needy children. It was found that this not only improved their general health but had a favorable effect on class work and attendance.

2. As a result of a study of conditions in the community, a district-wide recreational program, centered at the high school, was inaugurated for adults and students. A camp in the mountains was leased to provide 'outings' for the under-privileged children. The home economics teachers worked with the community on a program of home beautification. Students in biology classes grew many shrubs and plants for distribution in the community. These activities resulted from classroom work.

3. As a result of studying the economic conditions in the community, the following things were accomplished:

A hay baler was bought cooperatively so that more feed might be stored for winter use; a garden and poultry club was organized with membership open to all high school students; over 200 dozen eggs and 90 pounds of poultry were marketed cooperatively; over 1,000 baby chicks were bought cooperatively; a

night class in agriculture was organized for out-of-school boys.

4. The economic life of the community was improved by the establishment of a canning plant, a refrigeration and meat curing plant, a community hatchery, the planting of thousands of trees and the terracing of land. Pupils did not formerly engage in such activities since no effort was made to adapt the work of the school to community needs." [6]

At times, the teachers participating in the Southern Association Study have been encouraged to work *as* some other teachers have worked in devising ways of achieving their own school's purposes, but the staff of the Study has not encouraged one school to imitate *what* another has done. The soundness of this position, assumed by the staff, has usually been accepted by others engaged in the Study. This is especially true in situations where *what* a school or teacher has done to better the educational program assumed a highly specific and objective form. For example: it would be readily accepted that a cooperatively purchased and operated hay baler, although obviously an effective means of improving the economic status of a rural community, would probably be inappropriate to the needs of an urban community. But the undesirability of schools imitating *what* another has done to develop critical thinking or a better command of a subject-matter on the part of pupils is not so generally accepted. In the schools of the Study neither type of imitation has been encouraged.

[6] *The Southern Association Study, op cit.*, pp. 58–59.

The sampling of changes that have been made in the schools, listed above, and those reported elsewhere in publication of the Study assume their true significance when it is understood that they represent in each case a *means* which, in the judgment of a group of teachers, seemed likely to result in the improvement of their own school program. The ends sought through a school program and the consequent improvements sought, are those cooperatively agreed upon by the school faculty, pupils, and parents in the community concerned.

Throughout the Study evaluation of the changes made in the schools' programs, in instructional procedures, and of the results attained has been carried on as a continuing and integral part of the total effort to achieve the purposes which the schools accepted as worthy. Such data as are now available indicate that many of the schools have accomplished improvements in their programs, if "improvement" is defined in terms of increments of achievement in purpose. The Southern Association Study is now in mid-stream and no terminal date can properly be assigned to a study having its character. Many unfinished investigations are uner way. These investigations will be continued and the work and general progress of the Study will be reported, from time to time, in future publications.

A PHILOSOPHICAL BASIS FOR SELECTING AND ORGANIZING ACTIVITY—SUGGESTIONS IN ELEMENTARY SCIENCE PROGRAMS

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In professional literature there are isolated statements of opinion regarding the selection and organization of teaching suggestions. Collected and properly organized, these statements call attention to aspects needing consideration and, by giving arguments for and against certain procedures, they aid in crystallizing a philosophy.

To discover as many of these statements as possible, the writer investigated periodical literature, books dealing with science teaching in the elementary schools, and introductions of courses of study. All opinions so discovered are given in the original report of the writer. (29)*

The findings are not conclusive. Some aspects are discussed by a number of authorities; others by but one or two; and some aspects are not discussed at all.

A noteworthy finding is the agreement in expressed philosophies. The wide variety of practices encountered in courses of study would seem to indicate wide differences of opinion, and one would expect marked disagreement between those who champion "Elementary Science" and those who champion "Nature Study." Except for words of caution regarding certain practices, however, little apparent disagreement was encountered.

It has been comparatively simple to set up a tentative philosophy based upon the opinions that were discovered. Admittedly, such a philosophy is incomplete and may not be universally acceptable in all its aspects. However, it may be of value to those setting up courses of study.

A brief summary of the philosophy is given below, together with certain of the opinions that seem best to amplify the various points of the philosophy. The writer assumes complete responsibility for the selection of such opinions.

A. The Need for Activity-Suggestions

1. Courses of study need enrichment with suggestions for activities.

> What the teacher needs now are suggestions—many of them. Being a busy person, who has only a limited amount of time for planning undertakings, she needs rather full suggestions and examples of successful experiences which other teachers have directed. (6:75)

B. The Purpose of Activities

1. Activities should aid in developing proper scientific attitudes.

> Briefly, it is the conviction of the writer that a science program should develop an honest, critical, open-minded impersonal habit and spirit of inquiry which recognizes the relationship between cause and effect and looks to proof for authority rather than to authority for proof. (22:8)

2. Activities should give training in scientific method.

> The important thing is that all instruction be handled in such a way as to stimulate the pupil's reflective abilities; challenge him to gather data, compare hypotheses, weigh evidence; to adopt only conclusions which the evidence will support, and hold them only so long as the evidence continues to support them. (3:1000)

3. Activities should give an enriched experience background.

> Since education takes place through interactions of the individual with his environment, it is important that the

* Numbers in parentheses refer to items in bibliography at end of article; the second number refers to the page on which the reference is found.

child make a wide range of contacts and that these contacts be made in such a way as to call forth the exercise of the powers that we wish to develop. Elementary schooling has usually afforded few such direct contacts. Out of school contacts are many and varied but certain conditions essential to insure education interaction are frequently lacking. . . . Merely instructing the child with regard to his environment is insufficient. (6:6)

4. Activities should provide sense training.*

Children learn naturally from personal contact with the physical world through their senses. The use of books is helpful after the child has learned to read, but always he depends largely upon his senses. The use of the senses is the beginning of all education. . . . Our schools should have a considerable list of the best materials for sense training. (26:2)

C. Fundamentals Underlying the Selection of Activities

1. Activities should deal primarily with materials common to the environment of the pupils.

More time has been used teaching children about glaciers in Switzerland than about the constant freezing and thawing of soil in West Virginia and its effect direct and indirect on the lives of the people. More time is spent teaching about the aurora borealis than is spent teaching about the composition of the air about us, a part of which is so easily determined. Such a thing as teaching how our common machines work, why they work as they do, and the advantage of their working in such ways has scarcely been thought of as a part of Nature Study. Considering that we have so many machines in and about our homes today, this side of Nature Study should be given very careful consideration. (30:335)

2. The interests, needs and abilities of pupils must be considered when selecting activities.

Science in the grades aims to capitalize upon . . . natural interests, develop them and enlarge their scope. (4:254)

My point is that nature study, or elementary science, for the public school ought to be all for *sure human good.* We must winnow our science of the chaff and by careful selection fill the limited time with the best knowledge the experience of the race and modern science has to offer. (11:20)

Most of the teaching attempts go too far and the subjects have no vital connection with the pupil's life. (2:34)

Care must be taken throughout the course, to keep the material within the comprehension of the child. The organization of complicated material is beyond the capacities of the pupils in the first six grades. (23:3)

There is danger that the teacher will think of the concepts from a mature conception of a scientific principle or fail to see the significance of a simple concept to understanding and life of the child. (20:414)

D. The Choice of Types of Activities

1. There should be variation in the types of activities.

Such experiences should be varied as reading, discussion, experimentation, field work, and observation. (9:2)

2. The emphasis should be upon activities that provide first-hand experiences.

Nearly all pupils, even those with the best imagination and power of visualization, learn faster and more accurately in the presence of objective material. (17:10)

Nature study is studying things . . . not about things. (25:11)

3. Books, pictures, and other means of obtaining vicarious experiences are valuable when used to supplement first-hand experiences, but they should not ordinarily be used as primary sources of information.

Books have a very great value, but they give their information at second hand. A book tells what someone else thinks about something, and no reader of such a book can get as vivid or perfect a knowledge of the thing as had the author, who learned the fact first hand. (12:9)

Books should be used as references for verification or to carry a development

* The writer prefers to interpret this statement as meaning the development of *the habit of using the senses;* he is not certain that the senses themselves can be trained.

further than the personal experience will permit. (18:155)

If nature study is the study of nature, then certainly the study of pictures is not nature study. I do not mean by this that pictures do not have a place, and a very valuable place, in nature study. When they can be made to explain, to enrich, to beautify, a subject which has already had a good basis of actual observation, they are valuable. (27:22)

4. Identification activities are desirable but identification is not the only aim of science.

The naming of objects is necessary. It is the starting point, as a city directory is. But it is only the beginning of wisdom. (2:121)

5. Experiments of a simple nature have a part in the science program.

One activity which aids in the development in the use of the scientific method is experimentation in grade science. (16:670)

The experiment is the scientists's great test for truth. It is the basis of practically all science. . . . There are many simple experiments that would delight the children, give them useful information, and at the same time afford excellent practice in inductive reasoning. (12:40)

6. There should be activities which allow pupils to express themselves.

(Pupil) designed materials . . . tend to promote a keen interest in science and a better understanding of scientific concepts by the pupils. (10:212)

Of the many ways of learning, first-hand learning—such as doing, making, creating, taking part, etc.—usually make the most lasting development in understandings, skills. habits, attitudes and ideals. (1:2)

7. There should be extra-class projects, including home problems.

Get the children in the habit of seeing things about them. Have them report on what they see on their way to school or on visit to the country. (12:47)

Simple individual projects and experiments in school and at home are indispensable. (15:11)

E. The Creation of Activity-Suggestions

1. Objects are best studied in their natural setting.

The indoor study of things that naturally belong outdoors among other outdoor things, can never show their true aspect. (12:48)

2. The field trip is one of the best means of giving first-hand experiences.

The school journey is the most real and most concrete of all visual aid techniques because it brings the pupils into direct contact with objects and phenomena in their setting. (10:151)

3. Materials may be brought into the room for further study.

Objective material in the room, through its being constantly at hand, permits watching growth and development and other changes of specimens. (21:14)

4. Preserved specimens, though not ideal, can be used effectively.

Whenever the museum is a help to the study of life in the field, it is well and good. Some teachers may give a live lesson from a stuffed specimen, and other teachers may stuff their pupils with facts about a live specimen; of the two the former is preferable. (5:8)

5. Expensive and elaborate equipment is unnecessary.

Expensive apparatus is unnecessary; for elementary work it is more often a hindrance than a help, in that it tends to distract attention. (14:42)

6. Books, pictures, charts and the like should be chosen and used with care.

The literature of elementary science and nature study has a number of persistent inaccuracies that should be corrected. (28:665)

. . . the flat picture is a substitute for reality and in this respect may have definite limitations which the teacher should be aware of:

1. Flat pictures have but two dimensions.
2. Flat pictures are frequently not true in color.
3. Flat pictures are frequently not true in size.

(10:161)

Models are very helpful to science teachers, but they also have their limi-

tations. Models generally are not true in size or color. (10:191)

7. Provision should be made for physical activity.

It should be planned to have the pupils do. It is not denied that they may be instructed by what they see and hear the teacher do; but there is so much that the pupils can do for themselves, and the power they gain by doing, by working out patiently all the details for themselves, is so much greater, that it is nothing less than depriving them of their rights to fail in meeting their capabilities for work. Teachers are far astray when they do what the pupils should do, as when they assume to think for them. (14:189)

8. The teacher should rarely assume the role of authority.

Too much talking by the teacher allows the pupils' minds to lie idle and passive. (12:23)

Never tell the children that which they can find out for themselves. (8:3)

9. Facts alone should not be emphasized.

One may liken the preoccupation with fact getting to the procedure of exercising small muscle groups and developing local skills: . . . our practice of stressing only the fact-getting phases of a complete educational experience shows a lack of perspective indefensible in a broad educational philosophy. (6:6)

10. Abstractions should not be taught.

In practice, this means that the teacher . . . will direct many activities of value in the gradual development of intelligent outlooks, but it decidedly does not mean that she will preach these concepts as abstract statements before the child is able to comprehend them. (6:43)

11. Suggestions for experiments should be carefully prepared.

No matter how simple an experiment is, it should be treated as though it were of real scientific importance. Experiments should be performed for the purpose of finding the answer to some question or problem rather than for demonstrating the truth of some fact or opinion that has been previously presented. Whenever a problem arises that can be settled or solved by an experiment, the experiment is always the logical procedure to adopt. It will be of infinitely more value in promoting real learning than any amount of talk or reasoning about the problem. (19:69)

12. The scientific method should be in continual use.

The best training for the use of the scientific method in meeting the problems of life is to employ it throughout the science course. (6:53)

A most pernicious habit, and one very easily acquired, is that of asking the pupil a question which will start him guessing, thus deceiving himself into the belief that he is actually reasoning. (14:27)

. . . the teacher is often tempted to present the generalization of the learning element first and then proceed to prove that it is true by citing illustrations. This procedure results in a telling type of science and offers little opportunity for the developments of skills in scientific thinking and habits of free inquiry which are the real goals of science teaching. The teacher must be constantly on her guard to keep the problem in the foreground instead of the answer to the problem. (19:69)

Why not let it go with one experiment? Because just one case is not sufficient for a generalization. (12:41)

It is well to verify observations and conclusions on different days. . . . This develops an intellectual habit of taking nothing on hearsay or for granted. (2:49)

13. Animistic interpretations of phenomena should be avoided.

It is unfortunate that teachers frequently aid in strengthening faulty or vicious ideas about Nature by having animals seem to talk, or saying that Mother Nature plans thus and so. . . . (18:12)

F. The Organization of Activity-Suggestions

1. There should be evident a carefully planned sequence of experiences, beginning with and building upon the early experiences of childhood.

This course has been planned to give a continuity and sequence in the occurrence of objectives from one grade to

the next. This has several advantages: First, it provides for use of previous knowledge and skills in the new experiences, thus assisting in the learning process and doing away with the need of formal review. Second, it avoids harmful duplication and gaps. Third, items are not isolated but are related in natural sequence. Fourth, as the child advances, units of study which might otherwise be very difficult are easily mastered because their prerequisites have been taken care of in the previous grades. (13:11)

2. Before vicarious experiences are introduced, there should be established a background of first-hand experiences.

   Through open eyes the child should see the common things about him; and then through imagination he may visit distant lands. (8:1)

3. Activities should be organized on a seasonal basis.

   Every effort should be made to teach seansonally. . . . It is practically impossible to give first-hand experiences with real situations otherwise. (30:332)

4. Correlation and integration may be carried out if this can be done without harm to the science program.

   Probably no subject in the elementary school curriculum offers so much material to vitalize other subjects as does elementary science. (17:10)

   It is not reasonable to suppose that elementary science must correlate and be integrated at every instance. (24:865)

   . . . there are many possibilities of advantageous correlation and many possibilities of serious incoordination. (7:12)

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SCIENCE TEXTBOOK ILLUSTRATIONS

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Twelve years of experience in science classrooms has resulted in a growing conviction on the part of the writer that the actual value of textbook illustrations in helping pupils learn science is problematical if not nil. This belief has grown with the observation of more and more pupils who seemed to pay little or no attention to the illustrations in the books during supervised study periods.

Since visual materials are unquestionably an aid in certain types of learning one would hesitate to recommend the selection of textbooks with fewer illustrations. There seemed to be a definite place for an objective study concerning textbook illustrations and their use by pupils so that other teachers might be convinced that a real problem exists.

In the fall of 1939 two good publishing houses were asked how they selected the illustrations that were used in their books. Both answered very courteously and admitted that they had no definite criteria. One letter contained this paragraph: "In our work here, we depend on the intuitive judgment of the authors and editors to make a selection of pictures which will appeal to the pupil and the teacher. Naturally, this often parallels the popular interest as manifested in newspapers, current periodicals, and books that have already proved successful with young people." Both companies expressed an interest in any studies on textbook illustrations and since it seemed obvious that other people were as subjective as the writer in their estimates of the value of illustrations, a series of studies were started at the University of Iowa.

Three questions seemed to be pertinent:

1. How much space in textbooks is devoted to illustrative material?
2. Do pupils study or even look at the illustrations in books?
3. Do textbook illustrations that are properly used by pupils and teachers contribute to pupil achievement?

There have been at least three published studies on the amount of illustrative material in general science and biology texts which would help to answer the first question. To the writer's knowledge there are no published studies that will help in answering the last two questions.

During the past three years a large amount of data that helps to clarify the answers to the above questions has been accumulated. Both general science and biology textbooks have been analyzed to determine the amount of space devoted to illustrations. One study of pupils' use of

illustrations in a biology text has been made and two studies of the influence of textbook illustrative material on comprehension are completed. These will be reviewed in the order listed above.

The analysis studies revealed that books are fairly uniform in the relative amount of space utilized for reading material and for illustrations. Of seven general science books analyzed, one had 38.3 per cent of its total page space devoted to illustrations. The others had a smaller space for illustrations but the smallest per cent was as high as 20.1. Of eight biology books analyzed, the highest per cent of total page space was 29.2 and the lowest 15.6. The average for all fifteen books was 22.9 per cent.

If we consider that one-fifth of the total page space of a textbook is covered with illustrative material it seems quite important that the teacher recognize the need for proper use of this material. Many teachers consider illustrations primarily a selling device of publishing companies. Other teachers believe that the inclusion of more illustrations adds to the pupil's interest in the subject, but they question the teaching and learning value of the illustrations.

It should be obvious that in order to learn from an illustration a pupil must examine it rather carefully. Whether pupils do or do not study illustrations has been a moot question. Some data we have collected do provide at least a partial answer. The illustrations used were in *Biology for Today* by Curtis, Caldwell, and Sherman, Ginn, 1934, pages 161, 162, and 163. A series of test items covering the information contained in each picture was built. These were items that could not be answered except by those who had examined the picture and concerned points that the average pupils could be expected to notice.

On the days the tests were administered the pupils were given a thirty minute supervised study period to study five pages which included the illustrations. No emphasis was placed on studying the illustrations and the test came as a complete surprise. However, the pupils were told that the tests would not affect their grades. Three hundred forty-five pupils have written these tests and 57 per cent of the total number of responses have been correct. It is also obvious from pupils responses to certain of the questions that many of those who looked at the illustrations did not read the legends under them. It is also worth noting that based on the total possible responses 19 per cent were omitted. It is probable that many of the omissions were the result of lack of observation of the illustrations.

These results show that there is reason to be concerned about pupil use of a learning aid that occupies approximately one-fifth of the space in textbooks. However, in the following paragraphs there is evidence presented that indicates that even though approximately half of the pupils can not answer questions concerning illustrations accurately the may still have value as learning aids.

One experiment to determine the value of illustrative materials in a general science text involved six general science classes that were divided into two groups of three classes each. One group of three classes used their basic textbook and the other group of three classes was given mimeographed material that was exactly like the textbook except for a small amount of rewriting that was necessary because of the omission of all illustrations.

Before assigning books and mimeographed materials, all pupils wrote a pretest. These tests were corrected and the scores tabulated. Study materials were then assigned and the same supplementary reading assignments given to both groups. Study helps prepared by the teacher were identical and the classroom procedures were the same. These included experiments, demonstrations, projects and supervised study.

The unit of work was completed in three weeks. Then the test previously used as a pretest was given as an achievement test. These tests were corrected and the scores tabulated in order to compare the achievement of the two groups. In making the comparison the number of points gained or lost after studying the unit was used.

Table I shows the statistical data.

TABLE I

	Pupils Using Textbook	*Pupils Using Mimeographed Materials*
The Number of Pupils Involved	71.0	88.0
Mean	5.77	5.03
Standard Deviation	2.38	2.33
S. E. of Mean	.2825	.2484
S. E. of Difference	.376	
Significance Ratio	1.97	

The significance ratio of nearly 2 per cent shows that it is very probable that the difference in achievement was caused by using mimeographed material. Just how the pictures functioned is still an open question. Even though they may be primarily motivating devices that encourage more careful reading rather than direct contributors to learning their presence is justifiable.

A similar study with biology students and covering two units provided further evidence that pictures and diagrams in textbooks aid pupils in understanding the concepts presented.

On the basis of these studies the three questions which were raised can be answered as follows:

1. Approximately one-fifth of the total page space in biology and general science books is devoted to illustrations.
2. Approximately half of the pupils use the illustrations in their science textbooks as learning aids.
3. Illustrations that are properly used by pupils and teachers do contribute to pupil achievement.

Perhaps the most valuable contribution of this series of studies is the objective evidence that teachers must help pupils learn to study the illustrations in their textbooks.

A CRITICAL ANALYSIS OF THE USE OF EDUCATIONAL MOTION PICTURES BY TWO METHODS *

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The acceptance of the educational motion picture as a means of instruction is noted by the following facts: (1) the increased number of projectors owned by the schools; (2) the greater number of producers of educational films; (3) the ever-increasing number of motion pictures suitable for school purposes; (4) the growing number of educational motion picture film libraries; (5) the introduction of courses in Schools of Education to prepare teachers for the use of Teaching Aids and to prepare administrators for the management of Departments of Teaching Aids. Probably the greatest single reason for the growth in the use of the Educational Motion Picture is the proof of its value made evident by the many research studies.

Of the many unsolved problems in educational practice relating to the use of the motion picture in instruction, that of methodology is now ripe for discussion and research. Every teacher using motion pictures uses them somehow, or by some method. The methodologies in using films vary widely with different teachers, with types of equipment, with types of films, and with the subjects and students being taught. The two methods most commonly

* An abstract of a doctoral disseration, Boston University Graduate School, 1941.

used by teachers today are: The Non-Preparation Method and The Auditorium Method.

The subject of methodology with which this study is concerned, is a fundamental problem relating to any instructional material. This investigation takes the form of a statistical analysis of the learning achieved by two methods of instruction through the medium of the motion picture as measured by objective, factual tests based upon the film content. It differs from other studies in that it discusses two distinct methods of film technique, showing the comparative results achieved by equated groups through each of the two methods.

The scope of the experiment included approximately 800 students from grades eight and nine. The material of instruction pertained to General Science in the eighth and ninth grades. Where group comparisons were made the groups were equated socially, educationally, and mentally. The experimental period extended over three years.

Five silent motion pictures were used from the list presented by Eastman Teaching Films, New York. Two sound films from Erpi Classroom films were used. One silent reel from the United States Bureau of Mines was shown. Objective tests, each based upon the content of one film were constructed and used, first as Pre-tests, and then as First Showing Tests and Second Showing Tests. Previous to the period of the experiment, the same films were used, after which tests were given to measure the learning. The tests used in this study were the results of the preliminary tests after revision, addition, and omission of test items.

Statistical procedures were used to validate the tests and determine their reliability. Whether any difference in mean per cents between any two groups was reliable or statistically significant was determined by use of the critical ratio, the statistical criterion of reliability.

The purpose of this study was to investigate, (1) the relative effectiveness of the *Intermittent Method* of film technique with regular size classroom groups, as compared with large size or auditorium groups, and (2) the comparative efficiency of film lessons with the *Non-preparation Method* and film lessons with the *Preparation Method*. By the *Intermittent Method* as used here with silent films is meant the *stop-start* method, allowing students to take notes, ask questions and contribute discussions during the film showing. By the *Preparation Method*, as used in this study, is meant a *three-step* method, namely, (1) a *Pre-test* without any previous preparation by the group to learn what the students knew about the subject matter of the film before seeing the film, (2) a *First Showing* of the film without any preparation for the study of the film and (3) a *Second Showing* with preparation for the study of the film based upon a list of questions directing the students in their study of the film. The first part of the study compared relative efficiency of the use of films with large groups when compared with small groups, both taught similarly.

The second part of the experiment compared each group with its own achievement on each one of the three successive steps of the instructional period.

The following conclusions are dictated by the experimental evidence.

TABLE I

SHOWING THE MEAN PER CENTS MADE ON THE FINAL TEST BY THE CLASSROOM GROUPS (1934–35) AND THE AUDITORIUM GROUPS (1935–36) ON EACH FILM TEST

	Mean Per Cent by Groups	
Name of Film	*Classroom Group 1934–35*	*Auditorium Group 1935–36*
"How Teeth Grow"	61.05	39.00
"The Blood"	50.00	44.38
"Control of Bleeding"	76.78	72.82
"Posture"	70.88	69.67
"Carbon Monoxide"	77.25	63.15
"Bacteria"	83.35	83.19

TABLE II

SUMMARY OF THE DATA SHOWING THE SCORES MADE IN THE MEAN PER CENT BY EACH GROUP AT THE THREE LEVELS OF THE INSTRUCTIONAL PERIOD WITH THE FILM "PLANT ROOTS."

	Mean Per Cent Made		
Group	*First Step Pre-test*	*Second Step First Showing*	*Third Step Second Showing*
9–1	23.50	55.50	83.30
9–2	20.25	47.70	79.60
9–3	15.95	38.78	62.00
9–4	20.15	46.50	63.65
9–5	18.00	40.65	86.00
9–6	12.85	43.20	61.65
9–7	17.50	42.30	77.90
9–8	10.00	38.60	52.15
9–9	13.75	30.20	64.80

TABLE III

SUMMARY OF DATA SHOWING THE SCORES MADE IN MEAN PER CENT BY EACH GROUP AT THE THREE LEVELS OF THE INSTRUCTION PERIOD WITH THE FILM "THE HOUSE FLY."

	Mean Per Cent Made		
Group	*First Step Pre-test*	*Second Step First Showing*	*Third Step Second Showing*
9–1	15.10	62.85	94.35
9–2	20.35	72.50	93.35
9–3	13.05	62.15	77.50
9–4	13.85	68.10	89.60
9–5	16.35	65.05	84.00
9–6	11.85	64.85	87.00
9–8	18.55	65.80	90.25
9–9	20.95	56.80	78.00

TABLE IV

SUMMARY OF RESULTS WITH RESPECT TO THE LEARNING OF EACH MENTAL ABILITY GROUP AT EACH OF THE THREE LEVELS OF THE INSTRUCTIONAL PERIOD WITH THE FILM "THE HOUSE FLY". SHOWING THE MEAN PER CENT MADE AT EACH LEVEL OF THE INSTRUCTIONAL PERIOD BY EACH GROUP:

	Mean Per Cent Made		
Ability Groups	*First Step Pre-test*	*Second Step First Showing*	*Third Step Second Showing*
High Ability I. Q. 111 up	21.85	76.95	96.65
Middle Ability 90–110	18.10	67.30	91.35
Low Ability 90 and below	14.70	63.70	86.65

TABLE V

SUMMARY OF RESULTS WITH RESPECT TO THE LEARNING OF EACH MENTAL ABILITY GROUP AT EACH OF THE THREE LEVELS OF THE INSTRUCTIONAL PERIOD WITH THE FILM "PLANT ROOTS"

	Mean Per Cent Made		
Ability Groups	*First Step Pre-test*	*Second Step First Showing*	*Third Step Second Showing*
High Ability	24.00	55.85	83.95
Middle Ability	18.50	43.40	74.55
Low Ability	18.25	37.50	65.90

CONCLUSIONS

The following conclusions are dictated by the experimental evidence:

1. Within the scope of this investigation the size of the class or group being taught affects the learning achievement of the students. In every instance of this experiment, the same methodology produced a higher degree of mastery with the small, or classroom group, than with the auditorium group.

2. The Pre-test results show the necessity of a consideration of what pupils know relative to an instructional unit, previous to the instructional period, if one wishes to measure the actual amount of learning due to any one methodology.

3. The Educational Motion Picture proved to be an effective instructional device for increasing factual learning. This conclusion confirms the findings of other investigations.

4. The higher ability groups achieved the greatest scores in the three steps of the instruc-

tional method; i.e., the higher ability groups achieved the higher mean per cent of the Pretest, Fist Showing and Second Showing. The middle intelligent groups *achieved a higher mean per cent* than the low ability groups on the Pretest, First Showing and Second Showing. The low ability group in some instances *gained* a higher mean per cent than either of the other higher ability levels.

5. In no instance in this study did the method of merely showing a film give a satisfactory learning result to warrant stopping the instructional period at this step.

6. In all instances in this experiment the amount of time spent in Step Three of the instructional plan which directed the students' study of the film with directing questions brought significant learning results.

As a main contribution, this study indicates to teachers that one of the present common practices of using educational motion pictures by merely showing the film Without Preparation of the class for the study of the motion picture is not an efficient method. To improve the efficiency in the use of educational films one of the methods proven to be efficient is the Preparation Method which prepares the students for the study of the motion picture by the use of directing questions.

This study further shows that by comparison the use of educational motion pictures is not as efficient with large groups in the auditorium as it is with small groups in the usual classroom.

As a limitation on this study, it should be noted that the subjects studied were problem and appreciation subjects, while the testing done was factual or drill type testing. Factual knowledge can be tested most easily, but may not be as important as other possible outcomes in the teaching of problem and appreciation units. Conclusions in this study are limited to the results of testing for factual knowledge.

SELECTING FUNCTIONAL SUBJECT MATTER FOR A GENERAL SCIENCE COURSE *

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THE PROBLEM

The growing recognition of the need for more careful consideration of the individual in our educational for living in a democracy is epitomized in a recent statement by Wood. In emphasizing the need in America for individualizing education, in contrast to the tendencies toward the more autocratic practices in totalitarian countries, he is quoted as saying:

"The most feasible and enduring way of harmonizing the interests of the group with those of the individual is not that of trying vainly to enforce conformity to a currently accepted pattern, but that of seeking everywhere, at every age level, to adapt education to the abilities, interests and needs of each individual pupil." [1]

The purpose of this study was to seek a way by which subject matter in general science might be selected with some degree of assurance that its content would serve efficiently in satisfying the needs of the pupils for whom it was intended. There is a wealth of subject matter in the science field, but it is evident, from a study of general science textbooks written for the intermediate grades, that little has as yet been concluded as to what materials may best serve to meet individual needs at specific levels. The writer has endeavored, in this study, to investigate the possibilities of a few commonly used media for provid-

* Based on a Master's Thesis entitled "A Study of the Abilities, Interests and Needs of Sixth-grade Pupils as an Aid to the Selection of Functional Subject Matter for a Seventh-grade Course in General Science," Boston University, 1940.

[1] Wood, Ben D., as reported in The Christian Science Monitor, Boston, Oct. 28, 1939.

ing such information in a particular locality, the information to be applied in the building of a seventh-grade course in general science.

THE METHOD

The media used in the study were (1) a comprehensive multiple-response test, (2) parent-provided information based on prepared questions, (3) teacher-provided information regarding individual abilities and interests, and (4) a check list for expressed interests. The investigation was applied entirely to sixth-grade pupils, they being the ones for whom the proposed course material was to be selected.

The material covered in the test comprised the average subject matter content of five widely used seventh-grade general science texts and was grouped under sixteen major topic headings. The number of test items incorporated in each topic group was governed by the average per cent of space given to that topic in the texts. One hundred fifty items were prepared, each having five possible responses. Following are two examples of the type of item used:

(a) The farthest from the earth that air is thought to extend is about—
1 (15 miles) 2 (50 miles) 3 (500 miles)
4 (1000 miles) 5 (6000 miles) ( )

(b) When a metal rod is heated it—
1 becomes bent 2 gets longer
3 gets shorter 4 gets heavier
5 gets lighter ( )

The topics covered in the test were (1) air and weather, (2) fire and heat, (3) water, (4) astronomy, (5) geology and earth science, (6) biology, (7) conservation, (8) nature, (9) evolution, (10) health, (11) food, (12) chemistry, (13) magnetism and electricity, (14) communication, (15) transportation, and (16) scientific method.

In addition to the test, a form was prepared, a copy of which was sent to the home of each pupil being tested. The forms provided space for the parents to fill in information based on their own observation of the child in connection with his apparent interests, problems, errors and shortcomings relative to certain broad science fields. Teachers of the pupils also kept a record, over a period of six months, of the questions relating to science topics which were asked by the children in their classes. These three instruments constituted the major source of information for this study.

Selection was made of two average sixth-grade groups for testing and observation. By way of a check on the reliability of the range-of-knowledge (multiple-response) test, a third group was selected from the ninth grade and given the same test. Table I gives, for each group, the average

TABLE I

COMPARATIVE DATA FOR THE THREE GROUPS

	Inteligence Quotients		Numerical Scores	
	Range	Average	Range	Average
Group I (Thirty Sixth-grade Pupils)	85–126	104	43–110	76
Group II (Twenty-five Sixth-grade Pupils)	75–125	102	34–109	73
Group III (Twenty-five Ninth-grade Pupils)	75–121	104	77–129	104

intelligence quotients, based on Otis Classification Test, Form A, and the numerical scores obtained on the test.

The test was to serve two major purposes: (1) to reveal the pupils' present scientific information, and (2) to act as a check list later for scientific interests.

The test results were tabulated so that both the correct and the incorrect responses of every pupil could be obtained readily. These results were then assembled under various headings such as comparative scores by topics, and correct and incorrect responses made by individuals. Five such listings were decided upon:

1. The sixteen test topics in rank order comparing the scores made by each group;

2. The per cent of responses in each topic of which pupils were uncertain of their answers;
3. Those test items which were answered correctly by eighty per cent or more of one of the sixth-grade groups;
4. Those test items which were failed by two-thirds or more of any one group;
5. Incorrect responses which were believed to be right by one-third or more of any one group.

By pointing out areas of apparently adequate information as well as areas where information was largely lacking or completely false, a basis was furnished for intelligent consideration of the relative importance of these items from the point of view of the readiness and needs of the pupils. May it be noted here that no attempt was being made to measure concepts or understandings, but merely factual information.

Of the one hundred fifty items presented in the test, twenty-one were answered correctly by at least eighty per cent of either of the sixth-grade groups. Material comprising these items came from all of the topics except chemistry, communication, and transportation. According to scale scores obtained, items belonging to the topics biology, electricity, nature, and health were found to be most frequently answered correctly, while items belonging to the topics communication, chemistry, geology and water were least frequently answered correctly.

Uncertainty in answering was, of course, more common in the sixth-grade groups than in the ninth, and items marked in this way were treated the same as material about which the pupils were wholly ignorant. In analyzing the items which were answered correctly by eighty per cent or more of the pupils in a group, considerable discrepancy was noted between the scores of the two test groups, intimating a probable lack of standardization in previous instruction. In such cases the material was given the same importance as though both groups had shown a deficiency in it.

Of greatest help, however, in obtaining pupils' factual misinformation were the items found to be failed by two-thirds or more of a group, and the wrong responses which were believed to be right by one-third or more of a group. There were fifty-one such items in the former listing and fifty in the latter. They included items under every one of the sixteen topics except biology, and magnetism and electricity.

These various analyses yielded sixty-one items out of the original one hundred fifty which could be considered as least understood by the sixth-grade pupils. With the aid of Hull's [2] tables they were ranked according to per cent position, the most difficult items appearing first. The first three and the last three, with their respective scale scores, are presented here.

	Correct Statement of Item	Scale Score
1.	A hygrometer is an instrument for measuring moisture	94
2.	When birds fly south early it is a sign of a failing food supply	79
3.	Loam is a kind of soil which is partly sand and partly decayed material	71
59.	Scientists think that the very first life on the earth may have been plants	16
60.	Electric light wires are shorter in winter than in summer because metal contracts when cooled	12
61.	Which of the following could be used as fuel? (Answer) Straw	6

PUPIL INTEREST

To ascertain pupil interest in the subject matter the same list of one hundred fifty multiple-response items was presented to the pupils again after an interval and they were asked to check those which they liked or would be interested in learning more about. Because of the possibility that success in answering might have influenced certain of their choices, the coefficients of correlation between apparent knowledge and expressed interest in the items were computed according to Pearson's Product-moment Formula. Comparison was made

[2] Hull, Clark L. *Aptitude Testing.* New York: World Book Company, 1928, pp. 386–389.

on the basis of topics and the results showed the following correlations: Group I, r = − .58; Group II, r = + .33. The correlation for Group I, while a significant figure, is negative, indicating that the pupils' choices of interesting items could not have been made on the basis of those which were easy to answer, but rather did they choose those items about which, largely, they were ill informed. The coefficient for Group II is not great enough to be significant and therefore can be ignored.

Further substantiation of the low positive correlation between apparent knowledge and expressed interest was found in comparison of the number of times the fifty most easily answered items were checked as interesting with the number of times the most difficult items were checked. The difficult items received 631 favorable checks while the easiest ones received 537.

Supplementing the information derived from the test were the lists of questions obtained from the teachers and parents of the pupils as well as the parents' observations regarding their particular children's needs and shortcomings from the standpoint of their attitudes toward scientific things. Both of these sources were expected to yield information of perhaps more functional character than did the test due to the fact that, coming unsolicited from the children, it represented questions arising purely from their felt needs. Space will not permit a discussion of these questions, except to say that there was evidence that the interest factor varied slightly between those items which were checked on the test and the unsolicited questions which were asked in the classroom and at home. The home questions particularly showed the influence of the environment, the majority of them being connected with some phase of home life. On the whole, however, they gave evidence of interest in much the same type of material as the questions asked and checked in school.

The amount of material obtained from parents regarding their children's errors, shortcomings, and handicaps, while small (only one-fourth of the parents solicited responding), the writer believes should be of sufficient value to warrant wide use in a study of this type. The experience in this case shows, however, that it would take considerable time to build up sufficient interest among the parents who were to take part to insure the recording of careful and worth-while observations in sufficient quantity to be of real value. The needs and shortcomings most prominent in the reports received were poor posture, careless eating habits, reading in poor light, inordinate fear of certain animals, and lack of interest in the care of the person.

CONCLUSIONS AND RECOMMENDATIONS

Certain of the conclusions which follow are substantiated by information presented in the original study but not discussed here. They are included in order to present a complete picture of the field covered.

1. Textbooks in seventh-grade general science vary widely in their subject matter content, therefore any one text is not a reliable source of information as to what to teach.

2. Pupils at the age tested apparently entertain many definitely wrong concepts of the scientific facts presented in seventh-grade texts.

3. The science materials on which these pupils seem most poorly informed appear to be largely in the physical and chemical fields rather than in the biological and natural.

4. An earlier introduction, than has been the practice, of certain fundamental concepts into the course material seems desirable because of the failure of the ninth-grade pupils to show themselves sufficiently conversant with these concepts. These relate chiefly to understandings in the fundamentals of chemistry and physics.

5. Pupils' expressions of their own in-

terest by using a check list differ somewhat from the apparent interests to be interpreted from their unsolicited questions.

6. The type of science material in which pupils expressed greatest interest seemed to be controlled to some extent by home environment. Pupils of parents belonging to the higher income group were more interested in technological phases of the subject matter, whereas other pupils were interested largely in the utilitarian phases.

7. There seems to be no basis for attributing in general a higher interest factor to one science topic than to another. Rather does interest seem to center in particular phases of those topics, in connection with which the child has had some stimulating experience.

8. Pupil needs, as seen by the parents of these pupils, are related chiefly to matters of health and physical care.

No attempt has been made to list specific subject matter to be used in a course. The nearest approach to such a listing is the sixty-one items about which the pupils were found to have the least knowledge. They indicate the type of material which it seems most necessary for them to have and which should serve as the minimum requirement about which the whole course might be built.

It is recommended that in making up the course material consideration be taken for the types of material which have apparently the greatest interest for these pupils and that ways be found for adapting the less interesting, but still important, material to these types.

The functional value of any subject matter which may teach better health habits and which may enable pupils to use more intelligently and safely the time spent out of school is a foregone conclusion. On the evidence presented by parents of these pupils it is recommended that particular attention be given to teaching an appreciation of the need for intelligent care of the body in the simpler matters of personal health such as posture, fresh air, good light and general cleanliness. It is also recommended that as close contact as possible be kept with the leisure time hobbies of these pupils in order that the most may be made of the interest factor therein, and that the pupils be given the benefit of instruction in any necessary fundamental understandings that would enable them to carry on these activities with intelligence and safety.

IMPROVED EDUCATION OF SCIENCE TEACHERS

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Science instruction in the teachers colleges knows its opportunity. Favored with comparative freedom from academic restrictions it takes its course. Progress determines the changes. How recognize growth? What are the aims? How attain the goals? Action at this level moves all education.

IMMEDIATE OBJECTIVES

Truer correlation of the sciences constitutes a primary need. Treatment of content from Astronomy, Physics, Chemistry and Geology in one textbook and that from Botany, Zoology and Physiology in another does not necessarily establish functional relationships. A composite discussion of all of these sciences gives no surer accomplishment. Determination of valid curriculum essentials precedes attempts at fusion. Consideration of an interacting biological and physical world gives the master key to selection of facts for inclusion in the science curricula of the teachers colleges. This

same interpretation will then indicate the interconnections. Our work demands a decrease in the number of special divisions of the sciences.

Upon accomplishment of such correlated courses in science for the first two years of the teachers college curriculum comes specialization in these kinds of courses for the third and fourth years. At present we generally present advanced work for teachers in the usual divisions of the sciences. Even where fused courses operate for the freshman and sophomore years these people go on to the traditionally established sciences. The later efforts of students in the teachers colleges partakes too much of the nature of preparation for research in science. Education wants concepts of specialization in terms of the responsibilities demanded of teachers. Satisfactory development of this type of advanced study in science awaits, however, achievement of a firm basic synthesis for the first and second college years.

How keep our courses balanced? Select and utilize only those facts of science which contribute to an understanding of *ever more comprehensive* generalizations. The details of science accumulate daily. Curriculum composition should concurrently decrease the array of principles. We must recognize this double process and administer the possibilities. Research in the teaching of science tends to fix both the number and the form of our large concepts. Research in the sciences multiplies available particulars and kinds of facts. Synthesis of generals and test of the contributory specifics will reorganize and order curricula.

Progress demands direct instruction in scientific method and attitude. Valuable data relative to the elements of scientific thinking are available. We recognize precise distinctions between method and attitude. We accept the desirability of these subjective goals. Yet subject matter subordinates consideration of procedure. Accurate thinking constitutes a major objective. Process values should prescribe both curriculum and method.

And then professionalization. We should fuse many of the facts and principles from child psychology and the psychology of learning with content from the biological and physical sciences. Courses in Educational Biology have satisfactorily attacked this problem but not so the other sciences. Physics and Chemistry particularly need such treatment. Courses in Psychology in the teachers colleges are sometimes too abstract for the students and they seem to grasp only a few of the possible relationships with the teaching of science. Our psychology will become truly pragmatic and our sciences intrinsically professionalized by judicious combination.

Common and practical equipment provides valuable experiences. We sometimes use too many complicated pieces of apparatus. Many scientific and instructive concepts for students in the teachers colleges come from ordinary materials. Indeed, the community furnishes significant problems as well as means for solution. The physical, biological and social environment presents a superior laboratory and a full supply room.

ATTAINMENT OF THE OBJECTIVES

Curriculum research in science should produce a reorganization and correlation by application of the concept of cyclic change. Rhythmic progression casts the universe. Scientific laws and principles attempt to explain this cadence. But an organization built upon these laws and principles, or combinations and aggregations of them, can miss the essence. Science instruction then echoes incoherently. Cyclic change comprehends the cosmos.

The beat of creation manifests in four areas. These are: (1) The cosmic cycles. Elaboration of the astronomical sciences teaches them. (2) The material cycles. Geology, Physics and Chemistry yield their identification. (3) The life cycles.

Biology recognizes them and the curriculum benefits thereby. Psychology however must have consideration. (4) The correlative cycles. These depend upon the other three and take meaning from them. The bodies of knowledge now called Economics and Sociology discover them and science humanizes to the extent that we recognize these relative cycles.

Use of these syntheses will help to integrate science education and accord it with Nature.

FACTORS AFFECTING STUDENT ACHIEVEMENT AND CHANGE IN A PHYSICAL SCIENCE SURVEY COURSE

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The study here described was undertaken as an evaluation of certain aspects of physical science survey courses. Several types of achievement and change made by students in such a course at Queens College in New York City were identified and the extent determined to which certain factors were related to these achievements and changes.

The physical science survey course is one of a variety of types of survey courses that have come into existence within the past thirty years. Before 1920 only a few pioneer survey courses were offered. After 1920 the number of courses so increased that in 1938 it was estimated that more than four hundred were being offered that included in them materials from the physical sciences. The total number of survey courses offered was estimated in excess of twice this number. Survey courses differ from the courses they have replaced in being concerned with broad areas of knowledge rather than in narrow areas of specialization; in being intended largely for students not planning to specialize in any of the fields covered by the survey course; and in attempting to draw from the fields of knowledge involved in the survey course those ideas and relationships believed to be of greatest current cultural value, rather than attempting to give a systematic treatment of an archive of knowledge. While much has been written pro and con concerning survey courses during the past few years, very few studies have been undertaken to evaluate the actual outcomes being achieved in them.

In the study of the physical science survey course at Queens College the chief achievement considered was success in the course as measured by the final grade mark. The correlation of final grade mark with final examination scores was 0.85. As the final examination had an estimated reliability of 0.955 it is quite likely that the final grade marks were also highly reliable.

Other achievements and changes considered in this study were based upon less reliable tests, but they were types of achievements and changes often sought in generalized science courses, as often revealed by educational writers and by statements of course objectives. The tests for measuring these achievements and changes included the following: an information test, a "thinking test" designed to measure the ability of students to apply science information in new situations, and a number of opinions tests. The information test consisted of two sub-tests, one a word test, and the other an astronomy test. Each sub-test consisted of two forms. Each form of the word test contained forty-eight scientific words or terms to be matched with their definitions. Each form of the astronomy test consisted of twenty true-false items and seventeen best answer

items. The two forms of each sub-test were made as nearly comparable as possible by matching the items of the two forms with respect to subject matter area sampled, and to estimated difficulty. In the pre-testing some classes used one form of each sub-test and other classes used the other form. In the post-testing each class was given the form not used in the pre-testing.

The "thinking test" consisted of a number of questions selected by each instructor and designed to stimulate the student's ability to apply information previously learned in new situations. Student responses to these questions were scored by having a group of "experts" rank them. These tests were administered only after the instruction period.

The opinions tests used were of two types. One consisted of a series of true-false statements, the students being asked to write criticisms or reactions to the statements. "Experts" were used to sort these responses along an opinions scale. The second type consisted of some multiple choice or best answer items. On both the "thinking" and opinions tests, correlations between the rankings and sortings of different pairs of "experts" were very high, but no numerical estimates of the test reliabilities were secured.

In analyzing students achievements in the survey course it was found that the mean scores of the students of the A grade group were higher than those of the B grade group on all the achievement tests used and on the American Council Psychological Examination. Likewise, the B grade group scored higher than the C grade group, and the C group higher than the D. About two-thirds of these differences could be considered statistically significant. The differences between the D and F grade groups were not so great, and did not always favor the D group.

It was found that measures taken at the beginning of the survey course could be used to predict with a high degree of accuracy the grade marks and final examination scores of the students at the end of the course. The most important of these measures was the information pretest. Also of predictive value were the scores on the psychological examination and data concerning sex and the number of mathematics courses and kinds of science courses taken in high school. Students repeating the survey course had a grade point average of 1.9 or slightly less than a D, as compared to 2.8, or slightly less than a C for students not repeating.

It was found at the end of the survey course that in addition to achievements and changes in information, the students could demonstrate some ability to apply science information in new situations, as measured by the "thinking test." Scores on this test showed rather high correlations with the grade marks, the final examination scores, and the information pretest and posttest scores. Correlation with the gross score of the psychological examination was somewhat lower, but was significantly different from zero. Students had also arrived at certain opinions at the end of the survey course, and had made certain changes in opinions during the course. As shown by the tests used, however, these changes were not always great, nor in the direction that would see most desirable. These indications may have been in part due to inadequacies of the tests used, but they probably also were in part due to the fact that the changes actually taking place were small. On a few of the opinion scales, scores of the students showed appreciable relationship to other factors such as science information, intelligence, and final grade marks. The number of these relationships, as indicated by significant correlations and other measures of association, however, was small. Different lecture and recitation section instructors seemed to affect differently only a few of the student opinions, but the differential influences of individual instructors ap-

peared to be slightly greater on opinions than on other types of achievement or change.

As no systematic attempt to modify student attitudes or opinions was made by the instructors it is hardly surprising that the changes indicated by the opinion tests were not great. It is often assumed, however, that if students increase their knowledge of science, then they will also see the implications of this knowledge to common superstitions and misconceptions and to their thinking with respect to such fields as the social sciences, philosophy, and religion. Many educators influential in the development of science survey courses have stressed the importance of developing attitudes in students which are in harmony with modern scientific knowledge. If such outcomes are of real value and, as the results of this study suggest, they do not develop automatically with increase of scientific knowledge, then they must be sought for directly. This would apply to the situation in which the study was conducted and probably to many other situations where similar courses are offered.

The finding that measures taken at the beginning of the course can be used to predict the final grade marks of the students also has implications. In most survey courses all students in the course receive more or less identical instruction and assignments. With the enormous differences in ability and preparation for the course that exist among students, this procedure would seem to penalize the less well prepared student by setting standards that are too high, and to challenge insufficiently the more able and better informed student. Probably the first requirement needed to improve this situation would be a fairly reliable means of predicting each student's potentialities for work in the survey course. This could be done best by adding to the tests now usually given beginning college freshmen a highly reliable information test covering all areas of knowledge to be dealt with in the survey course. Results on this test, combined with properly weighted scores on the psychological examination, would provide a rather adequate means of predicting success in the survey course.

Once results from this test were available, any one of several procedures might be followed. Students might be divided into sections according to their abilities. Practically all students could then be challenged to advance up to the limits of their capacities. A second possible procedure would be the greater individualization of work in the survey course. This procedure would require a pretest that was not only predictive, but also diagnostic, revealing the areas in which each student needed the greatest amount of work, and in which rapid progress could be expected. A very flexible instruction program would be necessary. Regular class meetings might be held, but in addition to these, opportunities for each student to progress according to his own abilities would have to be made. This would require special meetings, perhaps at irregular intervals; and individual consultations between instructor and student with individual assignments resulting. A third possible procedure involving less modification of present practices, would be the enriching of courses by numerous special activities which would be participated in to different extents by different students. These suggested procedures are by no means exhaustive. The procedure followed in any given school situation must of course be modified to fit the possibilities and limitations of that situation.

One other finding in the study has implications for present practices. On the basis of evidence gathered it seems that failing students who later repeat the survey course gain very little through this second exposure. Except in special instances, therefore, it would seem that students should not be permitted to repeat the survey course. Under the present regulations, in which a passing mark in the survey

course is required for graduation from the institution, a set rule that no student could repeat the survey course would probably work undue hardships upon some individuals. The wisdom of such a procedure would also be open to serious question without a more satisfactory means of distinguishing the failing students from the passing ones. For these reasons perhaps a better procedure would be to allow no credit for failure in the survey course, but allow the attendance at the class meetings to satisfy the requirement of the course for graduation. Other possible procedures might also be devised.

SCIENCE INSTRUCTION IN THE SCHOOLS OF MEXICO*

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In considering the teaching of science in the schools of Mexico it is desirable to first review the set-up of the Mexican school system in general, since any discussion of the teaching in one area is necessarily dependent upon the organized whole. The background of education in Mexico is so radically different from our own that a short explanation of the Mexican schools seems justified.

The elementary schools of Mexico at the present time consist of three levels of two years each, making a total of six years of schooling. These *escuelas primerias* as they are termed make up the amount of schooling required by law, and wherever one travels in Mexico he sees these schools, most of them housed in buildings which have been erected in the past few years. The era of Cardenas was a school-building era, and although Mexico's compulsory education was highly theoretical before his time, since then it has been largely actual. In these primary schools there are no electives, there is one teacher to each grade and an attempt has been made to correlate the work around problem solving situations. In this *unificado* elementary science usually has its part.

* The author acknowledges with gratitude the assistance of Dr. Enrique Beltran, Department of Tropical Diseases, Mexico City, and Miss Ellena Torres, Federal Department of Education, Mexico City, Mexico.

The secondary schools of Mexico are not so well scattered, there being eighteen federal secondary public schools in Mexico City with about twenty to twenty-five privately operated ones. In all the rest of the country there are probably seventeen federal and not less than fifty privately operated secondary schools. Such schools as operate through religious groups are under strict federal control and supervision.

In the secondary schools, the course consists of three years, and there is one prescribed course of study with no electives. This course of study includes at least one course in science each year. The sciences offered are Botany, Zoology, Chemistry, Physics, and a combination course consisting of parts of Anatomy, Physiology and Health. Each course has four sessions per week and each session is for fifty minutes. One of these periods is devoted to laboratory work and the other three to classes, quizzes, lectures and demonstrations. A teacher licensed in the physical sciences is not licensed in the biological sciences and *vice versa*.

I visited in the science classes of certain Mexican schools and may give my experiences in Cuernavaca, Morelos as being somewhat typical. Here the school building consists of several rooms opening onto a patio in the center. These rooms have no doors to close them off from the patio

and so the noise from the other rooms enters readily. I visited with Sr. Medina, a young science teacher who was much interested in his work.

In physics, Sr. Medina had about fifty-five youngsters of approximately twelve to thirteen years of age. The room was crowded as are practically all of the school rooms in Mexico. In common with most other schools, the children did not have textbooks in the subject. The only book was in the hands of the teacher, and from it he drew diagrams of levers on the board and the children copied them together with the explanations in their note-books. The teaching was of a somewhat conventional type, with the teacher explaining, then a child at the board solving a problem while the others looked on. Then a problem was given which all worked at, and later the teacher explained the assignment for the next day, which was on pulleys.

The teacher, Sr. Medina, had a free period next and during that time I showed him copies of several American science books which I had with me in my car. He was fascinated by the drawings in the books although he couldn't read English well enough to read the text. He said to me several times, "If my children only had books like these." Many teachers told me the same story in regard to texts. The science field has been scarcely touched in Spanish language textbooks and it is doubtful whether there will be any texts to compare with ours until such time as the government can finance them, because prices would be prohibitive for the general group of school children.

In chemistry, the time was taken up by solution of problems relating to the quantitative relation of hydrogen and oxygen in water. In general, although the terms chemistry and physics were applied to the courses, the very fact that they were being offered to children of from twelve to fifteen years of age precluded the advanced work which is given in many of our secondary schools in these areas. The lever work in physics for example was much the same as that given to our children in ninth-grade general science.

The teaching of the sciences in the advanced schools and in the various colleges of the University of Mexico is of great interest but since my work was mainly concerned with the public schools, that part of the work was not covered. In connection with this it may be said that there are few if any full-time professors in the institutions of higher learning in Mexico. Most of these people are part-time men who are engaged in some other occupation. For example, a professor of biology in the university will probably be a successful physician. I was told in Mexico that in some respects, for example in the study of tropical medicine, the University of Mexico is outstanding. Of course, it is a mistake to think of the University there as a well-knit, closely allied unit. Here it rather follows the European tradition.

For those who wish to teach school in Mexico there are two institutions, the *Escuela Nacional de Maestros,* or normal school, for those who will be elementary teachers, and the *Instituto Nacional de Magisterio* for those who are preparing to be secondary teachers. They are now housed in the same building in Mexico City. For the rural teachers there are special rural normals, some federal and some state, since rural teaching in Mexico is considered as a career in itself and not a stepping stone to a city position. Few American teachers are ever faced with the heavy responsibilities thrust upon Mexican rural teachers. They must be the real community leaders as well as the teachers. Most of their work must be done outside the school house. In some isolated areas they are almost the only adults in the community who are fully literate, although this condition is rapidly disappearing.

For training those who will be the agricultural leaders of the nation, the *Escuela*

Nacional Agricultura has been established at Chapingo, some fifteen miles north of Mexico City. Graduates here may become agriculture teachers or agricultural engineers.

The one school in Mexico really dedicated to the sciences is the *Instituto Politecnico* where the engineers, technicians and airmen are trained. It seems to be quite a forward looking institution. Another institution which will be of great value is the new psychology laboratory being set up under Prof. Luis Herrera in connection with the normal school. When completed it will be the only psychology laboratory to function as a part of the Mexican school system.

Those who are to become teachers in the Mexican elementary schools begin their teacher training at the age of twelve, just as soon as they complete their primary schooling. It seems strange to see a class of twelve year old children in classes in normal school learning how to become teachers. I attended several of these classes and was especially impressed by the fact that the professors never let the children forget that their learning was to be used to teach others. In one of these classes, a section in Botany, after the little twelve-year olds had each dutifully dissected a large lily and checked the various parts, each was then asked, "Now, what would you tell the little children you are soon to teach about this?"

In general, Mexico's schools seem to be in a state of becoming. They have grown and expanded so enormously in the past ten years that many desirable things have not yet come to pass. The teachers and educators there are making a fine attempt to bring Mexico to the front through education. There has been much propaganda against Mexico and Mexican education, part of it no doubt true, but everywhere in the Mexican schools there appears to be an earnestness of purpose on the part of teacher and learner which one sometimes fails to see in some of our own institutions.

TERM PROBLEMS IN SECONDARY SCHOOL SCIENCE

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Term problems are an integral part of the course presented to certain chemistry classes which operate upon an experimental basis at the Susan Miller Dorsey High School of Los Angeles. These classes are composed of three groups: terminal students, college bound science majors and college bound non-science majors. The interests of each of the groups are served by providing opportunity to participate in two major types of activities.

1. Class work upon problems of significance in the community, such as Control of the Water Supply, Science in Agriculture, Food Supply, and Cosmetic Preparations and Their Uses.[1]
2. Individual work upon problems of personal concern.

Each student is guided in his selection of a problem which interests him personally. It is not mandatory that the individual's problem be related directly to the subjects undertaken for class study. The findings of the individual are utilized by the group to the fullest possible extent,

[1] This phase of the work was described briefly in *School and Society*, November 15, 1941, *54*. 447–449. (Everote)

whenever possible. Conversely, aspects of class work frequently orient the individual in his special study.

The selection of the problem is made in first semester chemistry classes after an orientation period of approximately two weeks. During this period, the kinds of activities in which scientists are engaged and the relationships between science, particularly chemistry, and other major subject fields in high school are explored through discussions based upon student and teacher observations and investigations of science literature. Examples of available types of written materials are examined in class in order to determine their values and limitations. Students make preliminary surveys of materials available in school and neighborhood libraries and at home.

In the second semester of the chemistry year course, the student may select a different field of interest for a term problem, or he may make an intensive study of some phase of the first semester's problem. An example of this latter case is: Making Color Slides (a second semester study) based upon Photography in Everyday Life (a first semester study).

Requirements in both semesters are held at a minimum to allow as much individual initiative as possible. They include:

1. Consistent study of the subject throughout the semester,
2. Collection of written materials concerning the term problem and preparation of a bibliography,
3. Construction of models, charts, or collections which assist in the study,
4. Preparation of a written summary of technics used and information obtained.

Approximately one-fourth of all home work time is assigned to the individual problem. Definite written responses on the part of the students are requested from time to time. Examples of these include:

1. A statement of the technics employed to obtain information,
2. A tentative bibliography,
3. An evaluation of written sources utilized.

Other assignments allow students to proceed in any manner desirable to themselves without the necessity of preparing any immediate written statement of work accomplished. Brief preliminary reports at the midterm and concise summaries at the close of the semester are given orally. These reports keep the students in touch with each other's work.

Students are encouraged to contact commercial concerns; utilize government facilities, such as publications of the United States Department of Agriculture, lists of materials available from the Superintendent of Documents, and references from the Library of Congress; interview persons in the field; and review pertinent available literature. A careful account of information obtained from these sources is incorporated in the final written summary.

These types of work are facilitated by the maintenance of index files of manufacturers and distributors, and bibliographies of materials available from numerous private and government agencies for student use. A collection of reports of term problems prepared by students of previous semesters is filed in the science office for the use of the students. These are arranged according to subjects with an alphabetical and cross-reference card system which lists titles, student authors, and other helpful data.

Laboratory time is provided for the students who discover that experimental investigations will contribute to their term problem studies. Necessary preparation for this work is planned and outlined by the individual concerned. The outline of the procedure to be followed by the student is reviewed and criticized by the instructor prior to its application in the laboratory.

Interests and plans of the students in four classes participating in this work in the spring semester are indicated by the following table:

Subject Area	*Terminal Students*	*College Science Majors*	*College Non-science Majors*	*Total*
Adhesives	1	..	1	2
Agriculture	..	2	..	2
Aircraft	..	1	..	1
Alloys	..	1	1	2
Atomic structure	..	1	..	1
Beverages	..	..	1	1
Cellophane	..	..	1	1
Chemiculture	..	1	..	1
Cosmetics	4	..	1	5
Dentifrices	1	..	..	1
Digestion	..	2	1	3
Disease	..	..	1	1
Dyes	..	..	2	2
Elements (chemical)	..	3	3	6
Embalming	..	1	..	1
Explosives	1	1	1	3
Foods	..	2	4	6
Forensics	..	..	1	1
Forestry	..	1	..	1
Fuels	..	..	1	1
Gems	..	..	1	1
Glass	..	..	2	2
History of chemistry	2	..	2	4
Household	1	..	2	3
Leather	1	..	2	3
Medicine	1	2	1	4
Metals	1	2	5	8
Musical instruments	..	..	2	2
Narcotics	..	1	2	3
Office equipment	1	..	..	1
Paints	..	..	3	3
Paper	1	..	2	3
Petroleum	2	2	2	6
Photography	3	1	3	7
Plastics	..	1	5	6
Pottery	..	..	3	3
Printing inks	..	2	..	2
Rare gases	..	..	1	1
Rubber	3	1	1	5
Synthetics	1	..	2	3
Textiles	2	1	1	4
Tobacco	1	..	1	2
Thermometry	..	1	..	1
Warfare	2	2	..	4
Totals	29	32	62	123

Major subjects of the students indicate one basis for the diversity of interests of the students. These major subjects follow:

Name of Major	*Number of Students*
Mathematics, science and language	1
Mathematics and commercial	1
Industrial arts and science	1
Mathematics and social studies	1
Clerical	2
Mathematics and language	3
Science and language	4
Art	5
Social studies and mathematics	7
Social studies	8
Language and social studies	12
Mathematics	15
Science	15
Mathematics and science	21
Language	27
Total	123

Choice of the problem allows the terminal student an opportunity to study a topic

which orients him in his chosen field. The college bound student may benefit similarly. In addition, training is offered in literature study and the evaluation and organization of materials. High standards of written reporting are encouraged. These include attention to spelling and grammatical usage, accurate use of numerical quantities, neatness, organization of data, and inclusion of illustrative materials.

A follow-up study of two hundred and twenty-five students who have participated in work of this type is nearly completed. A comparison of the college grade point records of these students and students from other courses is one phase of this study. The data collected indicates that favorable results are obtained by students who have taken this high school work in past semesters.

A SYNTHESIS OF THE RESULTS OF TWELVE CURRICULAR STUDIES IN THE FIELD OF SCIENCE EDUCATION—I *

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An earlier phase of this investigation resulted in (1) the compilation of a list of 272 principles of physical science—physics (including astronomy), chemistry, and geology, (2) the assignment of values to 246 of these principles on the basis of their relative applicabilities in the solution of problematic situations commonly encountered in everyday living.[1]

In that part of the investigation which is reported herein these data have been utilized along with the results of earlier curricular studies whenever, in the opinion of the investigator, the data which they present are capable of contributing to the solution of the problem of this study. No attempt has been made in this section of the investigation to collect or to utilize previously undiscovered source materials.

PROBLEM

The purpose of this investigation is to determine what principles [2] of physical science are most important for general education.[3]

METHOD

The method employed in this study is based upon three fundamental assumptions. These assumptions are as follows:

1. Certain curricular studies available in published or unpublished form present lists of informational items [4] which have already

* Abstracted from one section of a Dissertation for the degree of Doctor of Philosophy, University of Michigan, June 1941.

[1] Wise, Harold E. "A Determination of the Relative Importance of Principles of Physical Science for General Education." *Science Education*, December 1941, pages 371–379, and January 1942, pages 8–12.

[2] In this study a principle is defined in terms of four criteria:

A. To be a principle a statement must be a comprehensive generalization describing some fundamental process, constant mode of behavior, or property relating to natural phenomena.
B. It must be true without exception within limitations specifically stated.
C. It must be capable of illustration.
D. It must not be a definition.

[3] The term "general education" designates those educational activities which are designed to meet the needs of all pupils enrolled in elementary and secondary schools (Grades I to XIV, inclusive) without regard to future vocational or professional interests.

[4] Any item of subject matter appearing in any one of the source studies and assigned to one or more of the principles utilized in this investigation is referred to as an "informational item" irrespective of its designation in the study from which it originally came.

been evaluated in terms of their degree of suitability for use at some level of general education as the term is used in this study.

2. Since a carefully guided study of such informational items undoubtedly contributes to the development of a functional understanding of certain principles of physical science, the relative values of these items, as determined by the statistical technique employed in each study, can be utilized as indices of the relative values, in each study, of those principles to an understanding of which the study of the items contributes.

3. If contributing studies [5] adhere to certain criteria, an acceptable statistical technique can be employed for synthesizing relative values thus assigned to principles within the different contributing studies and a final aggregate value can be arrived at for each principle to which items from each contributing study have been assigned.

In accordance with these basic assumptions, a contributing study was considered to be of value in the solution of the problem of the present investigation if it met the following criteria:

1. It must be of sufficient scope to include material drawn from the fields of physics, chemistry, astronomy, and geology, which is appropriate for general education.

2. A valid and appropriate research method must be utilized for isolating various informational items—principles, topics, generalizations, concepts, etc.—which are suitable for general education at any grade level from one to fourteen.

3. An acceptable statistical technique must either be employed for arriving at the relative values of these informational items or the nature of the study must be such that the data which it presents can be made usable in this study by the employment of an acceptable technique.

An exhaustive survey of published curricular studies was made for the purpose of locating studies which met these criteria. In order to locate unpublished Master's Theses which might be utilized as contributing studies, the volumes of the United States Bureau of Education, *Record of Current Educational Publications* for the years 1930–39, inclusive, were consulted for titles which indicated studies of potential value. Twelve such titles were found and the original theses procured for inspection.

Several studies were found which were considered to meet the criteria but which included materials taken from both physical and biological science. In such cases, it seemed defensible to assume that, if only items belonging to physical science were utilized, the exclusion of biological items should not alter the ranking of items of physical science relative to each other. Two Doctor's Dissertations each contained two separate sections, both of which met the criteria. Accordingly, these dissertations were considered to constitute four separate contributing studies. Two Master's Theses completed at the same institution employed practically identical research techniques and differed only in that one placed major emphasis on material drawn from the field of chemistry while the other included material belonging to other areas of physical science. The results of these two studies were combined and treated as a single contributing study in the present investigation. Two studies, one a published study and one an unpublished Master's Thesis, were found, the use of which necessitated the supplying of a statistical technique for assigning relative values to the informational items used.

Ten studies were finally selected as meeting the criteria with such modifications as have been described. They were as follows:

1. Craig, Gerald S. *Certain Techniques Used in Developing a Course of Study in Science for the Horace Mann Elementary School.*

[5] Any one of the studies selected and used as sources of evaluated material during the progress of this study is referred to as a "contributing study."

Doctor's Dissertation, Columbia University, 1927.[6]

2. Curtis, Francis D. *A Synthesis and Evaluation of Subject-Matter Topics in General Science.* Ginn and Company, 1929.
3. Davis, Ira C. "Analysis of the Subject Matter in the Eight Most Widely Used Textbooks in General Science". *School Science and Mathematics* 31: 707–714; June, 1931.
4. Heiss, Elwood D. *An Investigation of Content and Mastery of High-School General Science Courses.* Doctor's Dissertation, Columbia University, 1932.
5. Muller, Ralph L. *A Synthetic Determination and Evaluation of Desirable Subject-Matter Topics in Consumer Physics.* Master's Thesis (unpublished), University of Michigan, 1937.[7]
6. Nelson, J. F. *Problems, Generalizations and Concepts, Basis to a Secondary Science Program.* Master's Thesis (unpublished), Colorado State College of Education, Greeley, Colorado, 1935.[8]
7. Newland, Eveus. *A Study of Allusions to Science in Magazines.* Master's Thesis (unpublished), Colorado State College of Education, Greeley, Colorado, 1937.
8. Partridge, W. A., and Harap, Henry. "Science for the Consumer". *School Science and Mathematics,* 33: 266–274; March, 1933.[9]
9. Robertson, Martin L. *A Basis for the Selection of Course Content in Elementary Science.* Doctor's Dissertation, University of Michigan, 1934.[10]
10. Weiser, Raymond S. *The Evaluation of Subject-Matter Topics in Descriptive and Consumer Chemistry.* Master's Thesis (unpublished), University of Michigan, 1937.[11]

The sources which were selected are representative of many different approaches to the problem of determining desirable subject-matter content for science courses. Collectively they include the following bases for selection of material: (1) analyses of textbooks, (2) analyses of scientific treatise written for the layman by authorities in the various fields of science, (3) analyses of publications intended for the consumer, (4) analyses of newspapers and periodicals, (5) judgment of science teachers, (6) judgment of specialists in science education, (7) judgment of educated laymen, (8) children's interests as revealed by questions.

Each of the forty-six informational items relating to the physical science which were included in Contributing Study Number I (the first section of the Craig study) was written on a three-by-five card, together with the figure representing the relative value of the item in this study. Each card was then individually checked against each of the 272 principles of physical science appearing in the investigator's list.[12] This checking in the case of each card involved the noting of those principles to an understanding of which the study of the informational item would be likely to contribute. Whenever, in the opinion of the investigator, such a relationship existed between an informational item and a principle, the number designating this principle was entered on the card bearing the statement and relative value of the informational item.

The next step in procedure involved the bringing together of all informational items assigned to each principle. In order to accomplish this, 272 tabulation sheets were prepared by writing each of the 272 principles at the top of a separate page and ruling two columns at the right of each page. These pages were bound in loose-leaf notebook covers in order to provide for the addition of pages as needed.

The informational item from each card was transferred to each page bearing a principle to which it had been assigned, by writing it on these pages under the heading, "Craig No. 1," and entering its relative value, opposite the item, in the first column at the right of the page. As this

[6] Two sections of this study were used as two separate contributing studies.

[7] The Muller study and the Weiser study were combined and treated as a single contributing study.

[8] The statistical technique for assigning relative values to the items from this study was supplied by the present investigator.

[9] The statistical technique for assigning relative values to the items from this study was supplied by the present investigator.

[10] Two sections of this study were used as two separate contributing studies.

[11] The Muller study and the Weiser study were combined and treated as a single contributing study.

[12] Wise, *op. cit.*

procedure was carried out, the defensibility of the assignment of each item to the principles under which it was placed was carefully re-checked.

This procedure was followed for items of physical science from each of the remaining contributing studies with the following modifications: (1) since items in the Curtis and Muller and Weiser studies were presented in outline form, it was sometimes necessary to retain, with a specific item, a word or phrase designating the sub-topic under which it occurred in order that the meaning of the item would be clear when it was removed from context; (2) as items from the Muller study were transferred to the tabulation sheets, their relative values were so adjusted as to be directly comparable to the relative values of items from the Weiser study;[13] (3) each item from the Nelson study was assigned a value in this study equal to the frequency of selection of the highest ranking book in which it was found; (4) as informational items from the Newland study were entered on the tabulation sheets, only those contexts were retained which were considered to be closely associated with the principle to which the

[13] This was accomplished by raising the maximum value in the Muller list from seventy to ninety, which was the maximum value in the Weiser list. The formula used, stated algebraically, was $X = \frac{90Y}{70}$, where Y represented the relative value of an item in the Muller study and X represented the final relative value of an item in the Muller study as compared to any item in the Weiser study.

TABLE 1

THE METHOD OF TABULATING DATA FROM THE VARIOUS CONTRIBUTING STUDIES AND OF ASSIGNING VALUES TO PRINCIPLES *

Principles and Informational Items	Relative Value of Item in Each Study	Relative Value of Principle in Each Study
25. A body immersed or floating in a fluid is buoyed up by a force equal to the weight of the fluid displaced.		
Craig No. 1		577.0
The principle of floating bodies	577.0	
Craig No. 2		57.0
The principle of floating bodies	57.0	
Curtis		63.7 †
Archimede's principle	63.7	
Apparent loss of weight of objects submerged in water	49.8	
Buoyancy	63.7	
Specific gravity	54.1	
How balloons and airplanes travel in the air	46.7	
Why iron ships float	49.8	
Operation of submarines	49.8	
Concrete boats	46.7	
Wooden boats	46.7	
Dry docks	45.8	
Means of navigation—sailboat	45.8	
Means of navigation—canal	45.8	
Use of compressed air—in submarine	52.2	
Use of atmospheric pressure—in balloon	49.1	
Use of compressed air—in floating of sunken ships	47.1	
Use of compressed air—in life belts	45.8	

* This table is intended merely to show the method of tabulating data from the various contributing studies and the method of assigning values to principles. It, therefore, shows data pertaining to but one of the 260 principles to which data were assigned in this section of the study.

† Items from the Curtis study may be used to interpret the method of assigning relative values to principles. Sixteen items from this study were assigned to principle No. 25; of these, the highest ranking item carried a value of 63.7. Accordingly, principle No. 25 was assigned a relative value in the Curtis study of 63.7.

TABLE 1—*Continued*

Principles and Informational Items	Relative Value of Item in Each Study	Relative Value of Principle in Each Study
Heiss		7.0
Conditions under which a body floats or sinks	6.0	
Principles underlying operation of the submarine	5.0	
Principles of operation of an airship	5.0	
Archimede's principle	5.0	
Operation of flush tanks	5.0	
Air is buoyant	7.0	
Objects immersed in water—buoyed up by a force equal to weight of water displaced	5.0	
Muller and Weiser		68.0
Archimede's law	68.0	
Archimede's law problems	41.0	
Archimede's law applications	67.0	
Specific gravity	59.0	
Density—determination of—solids heavier than water	39.0	
Density—determination of—solids lighter than water	33.0	
Density—determination of—the hydrometer	66.0	
Density—determination of—liquids	57.0	
Density—determination of—the density bottle	40.0	
Problems involving density and specific gravity	49.0	
Balloons	59.0	
Newland		65.0
Coal gas—as one of the first materials used in balloons	1.0	
Sodium Chloride—use of in soap-making process	1.0	
Hydrogen—as a gas for inflating sounding balloons	45.0	
Dirigible—construction and size	46.0	
Helium—as a safe balloon gas	65.0	
Zeppelin—construction of with reference to certain aviation developments	17.0	
Partridge and Harap		2.0*
Hydrometer—battery, oil.		
Gravity—lubricating oils.		
Robertson No. 1		3.56
A body immersed or floating in a fluid is buoyed up by a force equal to the weight of the fluid displaced	3.56	
The lifting force of a fluid is equal to the difference between the weight of the object and the weight of the same volume of the fluid displaced	3.08	

* A total of two different commodities (oil and battery) were associated with the scientific terms from the Partridge and Harap study which were assigned to principle No. 25. Accordingly, this principle was assigned a relative value of 2 in the Partridge and Harap study.

item was assigned; (5) it was apparent to the investigator that the potential contribution to the understanding of a scientific principle, of a study of any item from the Partridge and Harap source, depended upon the significance of the scientific term when used in connection with the associated commodities. Each item from this source was, therefore, assigned to those principles to an understanding of which its study in connection with the associated commodity or commodities might be expected to contribute. Since the technique utilized in this source did not reveal data concerning the relative importance of items, no values were tabulated for these items either on the cards or on the tabulation sheets; (6) a number of items from several of the contributing studies were considered to pertain to no principles of physical science whatever and thus were not assigned to principles.

(Continued in March issue)

Abstracts

SECONDARY SCIENCE

MEISTER, MORRIS. "Portable Kits for Demonstration Teaching; Shall Every Science Lesson Be Planned?; Suggestions for Lesson Planning." *The Science Classroom* 21: 1, 4; 1, 4; 1, 4; November, December, 1941, and January, 1942.

Portable kits could be used much more than they are for demonstration teaching. A portable telephone kit is described. All science lessons should be planned, but not always the same way. The type of lesson determines the kind of plan to be used. Effective lesson planning should be conceived in terms of large units of time rather than in terms of single periods. Some science lessons do not require written plans however. Brief outlines are given for planning: (1) Exploratory Period (2) Presenting New Concepts, (3) An Outgrowth or Application Lesson, (4) Pupil-Report Class-Discussion Period, and (5) A Review or Drill Lesson. —C.M.P.

WARNER, E. H. "Secondary School Physics in Arizona." *American Journal of Physics* 9: 368–371; December, 1941.

Physics is offered in about 60 per cent of Arizona schools and is elected by less than 5 per cent of the pupils. Arizona physics teachers are carrying a heavier teaching load than they should. The per cent of the teachers have sufficient physics credits for a major and 22 per cent sufficient credit for a minor. The average value of physics equipment is 680 dollars and annual replacement is 80 dollars. The author makes a plea for more high school physics courses and students and states some of the values to be derived from studying physics. He also states "There is a tendency in Arizona high schools which do not offer physics to present certain skimmed-milk courses, appealing to popular interest only, such as photography, descriptive physics, industrial science, and general science survey." —C.M.P.

HOLLINGSWORTH, J. R. "An Abridged Bibliography of Studies Pertaining to Physics Teaching." *American Journal of Physics* 9: 297–303; October, 1941.

This is a compilation of 264 reported studies pertaining to Physics teaching. Studies are listed by author, title, and place published. A guide to the studies classifies them as to problems covered. —C.M.P.

ROBERTS, HELEN M. "Photography in a Junior High School Class." *The High School Journal* 25: 26–27; January, 1942.

This brief discussion of how one school emphasized photography in connection with a unit on recreation offers many good suggestions. Perhaps a minor point, but one which is annoying to the reviewer, is that the writer has apparently been so conditioned by contact with modern advertising that she uses "kodak" as synonymous with camera throughout the article. The words, "kodak" or "kodaks" occur eleven times in the two pages and the word, "cameras" three times, whereas in all cases the more general term is probably the better choice.

O. E. UNDERHILL

HELLMANN, CHARLES I. "Miniature Slide and Film Strips." *The Science Teacher* 8: 20, 36; December, 1941.

Advantages of lantern slides as a visual aid are presented. Directions for making films by direct reversal are included. —C.M.P.

MASON, CHARLES M. "How We Use Motion Pictures in Chemistry Instruction." *The Educational Screen* 21: 12–13; January, 1942.

This is a brief description of eight years of experience at the University of New Hampshire with the use of motion pictures to supplement the regular instruction in chemistry. First tried out as an irregular program outside of classes with voluntary attendance, it proved so successful that it is now being incorporated as part of the regular classroom instruction. The author feels that sound films are much more valuable than the silent ones although a few of the best silent ones, supplemented by recorded music, are used. "In general one must differentiate between films designed to teach with, and those which merely explain a given chemical process." Four types of sources with advantages and disadvantages of each are discussed. O. E. UNDERHILL

CURTIS, WILLIAM C. "Project Teaching in High School Chemistry." *Journal of Chemical Education* 18: 293–295; June, 1941.

This article presents a descriptive list of projects in chemistry suitable for exhibits and posters. General types are: (1) History of Chemistry, (2) General Chemistry, (3) Chemistr and Industrial and Economic Progress and (4) Chemistry and Hygienic Progress. A classified bibliography is included. —C.M.P.

EVEROTE, WARREN P. "A Course in Practical Chemistry for High School Students." *School and Society* 54: 447–449; November 15, 1941.

The second semester of a course in high school chemistry taught by the author in the Susan Miller Dorsey High School of Los Angeles in-

cludes the following topics: (1) control of agriculture, (3) the food supply, (4) petroleum and its by products, (5) photography, (6) science in crime detection and (7) cosmetic preparations and their uses. —C.M.P.

CREW, M. C. "Some Projects in Consumer Chemistry." *The Science Teacher* 8:21; 34; December, 1941.

The following projects in consumer chemistry are described: (1) analysis of coal, (2) comparison of common water softeners, (3) amount of moisture in soap, (4) determination of various fractions in certain gasolines, (5) comparison of flash points for various lubricating oils, (6) making of tooth power, (7) preparing cold cream and vanishing cream, (8) testing soap for free alkali, and (9) testing for abrasives and soap in dentifrices. —C.M.P.

ANONYMOUS. "The Chemistry Examination of the College Entrance Examination Board." *Journal of Chemical Education* 18:441–443; September, 1941.

The College Entrance Board Examination in June, 1942, and thereafter is to be based on the chemistry syllabus which is included in this article in outline form. Part I deals with general chemistry and Part II with descriptive chemistry. It is recommended as essential that there be both individual laboratory work and class demonstration. It is also recommended that laboratory work constitute about one-third of the course and that it continue throughout the year. —C.M.P.

RALYA, LYNN L. "A Study of Some Concepts and Beliefs in Chemistry and Physics." *Journal of Chemical Education.* 18:364–367; August, 1941.

This paper reports the results of a science inventory test with 325 entering college freshmen. The test results on 84 items are included. Forty-five per cent believe that the four basic elements are fire, air, water and earth; eight per cent believe eels are sometimes generated from mud; fifty-three per cent believe the distant stars shrine because they are hot like the sun; only twelve per cent believe the moon shines by light reflected from the sun. —C.M.P.

SCHMEING, G. M. "Emotional Blocks That Prevent the Mastery of Chemistry." *The Science Counselor* 7:99–100, 126; December, 1941.

Seven emotional blocks preventing a mastery of chemistry are: (1) the feeling that the subject-matter is trivial in itself, (2) relatively important, (3) valueless in the student's chosen career, (4) unsuited to the temperament and special abilities of the student, (5) inherently too difficult, (6) unworthy of the intellectual and cultural cost, (7) not worth the priceless spiritual "sacrifice" entailed. Methods of eliminating these blocks are suggested by the author. —C.M.P.

KRAUS, JOSEPH H. "Experiments with Kitchen Chemicals." *Science News Letter* 40:360–361; December 6, 1941.

This article describes a series of chemical experiments that may be performed by using materials commonly found in the kitchen. —C.M.P.

FRANK, O. D. "Biology Xmas Festival." *Biology Briefs* 4:25–26, 32; December, 1941.

This is a very interesting article showing how a biology class worked out a project on Christmas and its biological implications. Interesting information is given about the cranberry, bayberry, holly, the origin of Christmas trees, the Yule Log, and poinsettia. —C.M.P.

BARTON, THOMAS F. "Establishing an Inexpensive Weather Station." *The Journal of Geography* 40:226–230; September, 1941.

This article explains how a science or geography class may set up an inexpensive weather station. —C.M.P.

FOWLER, GEORGE W. "Contributions of a Twelve Year Program in Science to the American Way of Life." *The Science Counselor* 7:107–109, 122–124; December, 1941.

This article points out ways in which secondary, junior high school, and elementary science courses can make concrete contributions to the American Way of Life through specific training in fact finding, thinking and judging. —C.M.P.

SCIENCE REFERENCE BOOKS

MORTENSEN, WILLIAM. *Flash in Modern Photography.* Camera Craft Publishing Company, 1941. 208 p. $4.00.

This book tells what pictures to take with flash and how to take them. There are 142 photographs and 55 lighting diagrams. Particular emphasis has been placed on personal record photography, portraiture and figure work, landscape and architectural photography, and synchro-sunlight photography. Practically no phase of flashlight photography has been omitted and a conscious attempt has been made at all times to keep the work as practical as possible. The author is one of America's best known photographers. —C.M.P.

MERSEREAU, SAMUEL FOSTER. *Materials of Industry.* New York: McGraw-Hill Book Company, 1941. 587 p. $2.00.

This is the third edition of a most useful book. Obsolete materials from preceding editions have been eliminated and new pertinent material added. All of the common materials of industry are treated, making it an excellent supplementary book for high school chemistry and consumer science courses, as well as for college survey course in physical science. Major topics considered are: forest products, non-metallic minerals, iron and steel, non-ferrous metals and miscellaneous materials (rubber, plastics, paint, stains, and varnishes). —C.M.P.

EDITORIAL STAFF OF JOHN WILEY AND SONS, INC. *The Manuscript.* New York: John Wiley and Sons, Inc., 1941. 75 p. $1.00.

To all authors and would-be authors, this book is a compendium of sound, practical advice. It is based on the experiences of an outstanding publishing house going back more than a hundred years. Part I deals with the preparation of the manuscript, illustrations, and completion of the manuscript. Part II discusses handling the proof, shipping of manuscript and proof, and formal publication and copyright.

Not only would the suggestions prove most helpful to authors of books, but also to authors and editors of articles. —C.M.P.

WACHTEL, CURT. *Chemical Warfare.* Brooklyn: Chemical Publishing Company, Inc., 1941. 312 p. $4.00.

Chemical warfare should concern all people, not only those in military service, but also civilians, for they, too, may be casualties of this weapon of war. The author of this book, now an American citizen, is well qualified to give information concerning gases used for warfare. He is the founder of the Pharmacological Section of the Kaiser Wilhelm Institute, and the founder and former director of the Institute of Industrial Hygiene and Professional Diseases of Berlin. The information given in the book is comprehensible not only to chemists, physicians, engineers, and military experts, but also to the laymen who are prospective individual victims of war gases.

Physical and chemical properties, tactical, technical, and toxic properties, toxic concentrations, and effects on men are given for many gases. Explosive Gases and Fumes, Treatment and Protection, and How to Develop a New Gas, are a few of the chapter titles of this valuable book.

—Roy V. Maneval.

ANONYMOUS. *Medical Manual of Chemical Warfare.* Brooklyn: Chemical Publishing Company, Inc., 1941. 129 p. $2.50.

The object of this book is to present briefly a resume of the effects of chemical warfare substances, and the methods that should be adopted to minimize them. Speedy recognition of the type of gas which has caused casualties is essential for rapid diagnosis and efficient treatment. This first American edition of a British compiled manual is intended primarily for the use of medical officers of our armed forces. In the chapter titles are found such subjects as these: Vesicant or "Blister" Gases, Lung Irritant or "Choking" Gases, Paralysant Gases, Arseniuretted Hydrogen Poisoning, Gases Used as Harassing Agents, Dangerous Gases not Used for Offensive Purposes, Protection Against Gas and Air Raids, Recognition and First Aid Treatment of "Gas Casualties."

The book is illustrated with several photographic reproductions. Some chemistry instructors may wish to add this to their reference shelves.

—Roy V. Maneval.

SYMPOSIUM. *Addresses and Proceedings of the National Education Association, 1940, The 78th Annual Meeting.* Washington: National Education Association, 1940. 990 p. $5.00.

Here are some 220 addresses and the proceedings of the Association as well as those of its 27 departments. Naturally many addresses are inconsequential. Those under Science Instruction give little idea of the problems leaders in science teaching are discussing. Some few addresses in the volume are truly great. It seems a shame to obscure them with so much that is trivial.

The volume is primarily important because it is one of a long series that records the trends and achievements in American education. Compare it with those of fifty years ago and you realize its full significance. —E.R.D.

ANONYMOUS. *Air Raid Precautions.* Brooklyn: The Chemical Publishing Company, 1941. $3.00.

This is the American edition of a British publication on air raids—a publication so very timely there, but which we hope will be of little use in America. But then one never knows! The publication is in ten parts as follows: (1) "Rescue Parties and Clearance of Debris," (2) "Organization of Decontamination Service," (3) "Organization of Air Raid Wardens' Service," (4) "Structural Defense," (5) "Local Communications and Reporting of Air Raid Damage," (6) "Notes on Training and Exercises," (7) "Gas Detection and Identification Service," (8) "Protection of Windows in Commercial and Industrial Buildings." (9) "Inspection and Repair of Respirators and Oilskin Clothing," and (10) "Care and Custody of Equipment." Each report seems to be carefully worked out with especial attention to practical situations.

—C.M.P.

PETERSON, ALVIN M. *Wild Bird Neighbors.* Milwaukee: Bruce Publishing Company, 1940.

Here are informal, personal little sketches gathered from personal observations of birds in their natural haunts. Among the birds described, some thirty-five in number, are woodpeckers, flickers, bluejays, orioles, meadow larks, catbirds, cowbirds, wrens, crows, hawks, bobwhites, several kinds of sparrows and grosbeaks, the cuckoo, the robin, and the mourning dove. Done in the same attractive manner as the author's previous book, *The A B C of Attracting Birds,* this book will be appreciated by all bird lovers for it gives many valuable lessons in protecting and fostering wild-life—such details as when they come, how they look, their mating habits, their eggs and nests, how they care for their young, how their song calls sound, and their economic value. Interesting glimpses of the birds themselves are given by the excellent photographs illustrating the book.

—Greta Oppe.

EVANS, EDNA H. *Bill and the Bird Bander.* Philadelphia: John C. Winston Company, 1940. 220 p. $1.50.

Boys and girls, as well as their fathers, will enjoy the nature pictures which are pictured here of a delightful boy named Bill and will read with consuming interest the summer adventures of Bill and the Bird Bander, Professor Weston, along the Tampa Bay area as they write the records of shore birds for the U. S. Biological Survey. Most of the experiences are the personal experiences of the author and her husband. This is an excellent book for home and school libraries to stimulate other "Bills" to study birds in their localities.

—Greta Oppe.

SHAW, MARGARET AND FISHER, JAMES. *Animals as Friends.* New York: E. P. Dutton and Company, Inc., 1940. 271 p. $2.50.

Animals as Friends and How to Keep Them gives essential information one should know about the care of animal pets. Written from the British viewpoint the book covers many animals Americans would expect to find only in the zoo rather than in the home. Information is given under these heads: scientific name, distribution, habitat, origin, description, diet, care in captivity, housing, breeding, gestation period, behavior, diseases and cures, best methods of transportation, cost and cost of upkeep. There is a foreword by Julian Huxley. Twenty-one diagrams and 16 photographs illustrate the book. Fifty-five animal friends are included distributed among the mammals, birds, reptiles, amphibians, fish and invertebrates.

—W.G.W.

MCCREERY, JAMES L. *Exploring the Earth and Its Life.* New York: Frederick A. Stokes Company, 1940. 312 p. $2.50.

Few have the opportunity to go out into the far corners of the earth to make explorations in real nature. But our large cities have brought materials together in natural history museums, where thousands of people visit. This book takes you on an excursion through many of the Halls of the American Museum of Natural History. It tells in simple non-technical language the story of material or life shown there. The museum can show much that you would hardly find in real nature today for it can take fragments of ancient living forms and reconstruct the animal and its natural environment neither of which exist on the earth today. The book makes interesting reading through a range from junior high pupil to adult. There are numerous illustrations.

—W.G.W.

DUNCAN, CARL D. AND PICKWELL, GAYLE. *The World of Insects.* New York: McGraw-Hill Book Company, Inc., 1939. 409 p. $3.50.

This fascinating story of the insect world will not fail to hold your attention. It is nontechnical, illuminating and satisfying. Structures, food habits, protection, social life and reproduction are topics which give one an intimate acquaintance with the life habits of the insects. Another appeal of the book results from the very unusual illustrations of which there are nearly two hundred. These consist of beautiful halftones and large sized drawings. A valuable list of insect reference books is found at the end of the book.

—W.G.W.

MORGAN, WILLARD D. AND LESTER, HENRY M. *Graphic Graflex Photography.* New York: Morgan and Lester, Publishers, 1940. 424 p. $4.00.

This is a master book for the larger cameras such as the Graflex and the Speed Graphic. Twenty photographic aspects help to make this a most comprehensive, practical, authentic treatise for users of all cameras. Altogether the books is an excellent source of information to all interested in photography whether because of their use of cameras or because they enjoy good photographs and desire to know more of the hows and whys of photography. The numerous excellent photographs add much to the interest and appeal of the book. Science teachers and science-club sponsors will find it an excellent reference.

In addition to the thorough treatment of the usual aspects of photography, there are chapters on such aspects as illumination and its control, documentary reproduction, aerial photography,

Book Reviews

SCIENCE TEXTBOOKS AND MANUALS

AHRENS, MAURICE R., BUSH, NORRIS F., AND EASLEY, RAY K. *Living Chemistry.* Boston: Ginn and Company, 1942. 546 p. $2.28.

Different! That is the word for this new high school chemistry textbook by three Denver educators.

It differs from the usual chemistry text in content, organization, vocabulary, illustrations, and size. The first 120 pages deal with the fundamentals of chemistry. Then follow the chemistry of the individual, the home, and the community. Much emphasis is put upon chemistry of everyday living. The unit plan of organization is used throughout the book. Exercises, objective tests, and problems for further study are found at appropriate places in the reading matter. Units covered include chemistry of gardening and hydroponics, chemical warfare, and cosmetics. The authors have defined or explained unfamiliar words when they first appear. The illustrations include excellent photographs, diagrams, graphs, and charts. Even the size of the pages is different—they are eight by ten inches.

Every high school chemistry instructor should inspect this new book. It it adaptable to the needs of practically all students who elect chemistry. A laboratory manual and teacher guide are in preparation. The authors are to be complimented on presenting this type of high school chemistry text. —Roy V. Maneval.

CARLETON, ROBERT H., AND WILLIAMS, HARRY H. *Modern-Life Science.* Philadelphia: J. B. Lippincott Company, 1942. 650 p. $2.40.

Physical science survey courses have become an integral part of the lower division curricula of many, possibly a majority of the colleges and universities, within the last decade. Movement toward such a physical science survey course for the upper senior high school levels has been much slower. Yet the tempo of this movement will likely be greatly accelerated as time goes on. There are many reasons why a physical science survey course for junior and senior high school students would be preferable to the usual physics and chemistry courses now offered.

Modern-Life Science is a physical science text intended for the senior high school. Content of this book is quite representative of the state of flux which now characterizes physical science texts on the college level. On the whole the content of this text seems to be well selected, although other equally desirable content might have been selected.

This book should appeal to students much more than the older physics and chemistry texts. There are numerous, attention-getting pictures. The functional point of view is evidenced throughout. Practical, consumer problems are emphasized. In the opinion of the reviewer, the authors have done a very good job, probably the best thus far, in preparing a text intended for the senior high school. There are eight units as follows: (1) "Fire, Fuels, and Heat", (2) "Power and Machines", (3) "The Sky", (4) "Weather and Climate", (5) "Materials for Construction", (6) "The Crust of the Earth", (7) "Light and Radiations", and (8) "Sound". —C.M.P.

SMITH, VICTOR C., AND TRAFTON, GILBERT H. *Science in Modern Life Series.* Philadelphia: J. B. Lippincott Company, 1942.

Book 1—*Exploring Science,* 458 p. $1.32
Book 2—*Enjoying Science,* 596 p. $1.52
Book 3—*Using Science,* 802 p. $1.80

This contribution to Junior High School science texts is one of the best. It has the unit-problem organization. It is well graded in difficulty of subject-matter and vocabulary. The books are strong in practical consumer science material and up-to-the-minute applications of science. Each unit has a preview, a review, self-testing exercises and much other helpful chapter-end material. The books are all interestingly written and attractively illustrated. They cover the usual field of science for these grades. The ninth-grade book of necessity repeats some of the earlier material, but added difficulty and a different approach do not allow interest to lag.

—W.G.W.

BLANCHARD, W. O. *Exercises in Economic Geography.* New York: McGraw-Hill Book Company, 1942. 64 p. $1.00.

This is a manual to supplement the textbook in an elementary college course in economic geography. It enables the teacher to provide supplementary exercises for meeting the usual weakness of students in place geography, and helps in forcing these students to a use of the atlas, maps and tables of data. Teachers may select from a large number of problems those best suited to their needs. The appendix contains a number of tables of data not otherwise readily available to the student for use in the exercises. —O. E. Underhill.

DAY, CHAPIN W., AND RITCHIE, MARGARET. *Studies and Activities in Biology.* Yonkers-on-Hudson: World Book Company, 1942. 218 p. $ .80.

The organization of this rather unusual high

school biology activity manual stresses important and significant principles rather than isolated observational techniques. Some of the first exercises, such as those dealing with normal distribution of a trait, measurement of cephalic index, and their application to the classification of human beings should serve as an immediate stimulus to pupil interest. The organization of units, and of problems within units, is such as to allow for flexibility in adapting the material to classes of differing needs. A key is given to aid the teacher in making maximum use of seasonal out-door materials. The manual is a very able combination of traditional biology laboratory exercises, field studies, teaching aids and self-testing devices, so organized as to emphasize the practical applications of biological principles to everyday living. It is edited by John W. Ritchie, author of *Biology and Human Affairs*.

—O. E. Underhill.

WENDT, GERALD. *Chemistry*. New York: John Wiley and Sons, 1942. 290 p. $1.75.

This is one of six texts in a set entitled *The Sciences*, designed for college survey courses. Dr. Wendt is not only the author of this volume but is also the editor of the series. After a preliminary introduction of three chapters ("The Nature of Matter", "Atomic Structure", "Chemical Reactions") the basic principles of inorganic, organic, physical chemistry and biochemistry are given in a chapter or two each. The closing chapter is entitled "The Future". The whole text is extremely readable yet presents important and fundamental principles in each field without sugar-coating. The author has solved in a very happy fashion "what to leave out". Many industrial and everyday applications are utilized to illustrate and make clear the general principles. The reviewer particularly liked the chapter on organic industrial chemistry. An excellent selected bibliography accompanies each chapter.

—O. E. Underhill.

EHRET, WILLIAM F., SPOCK, LESLIE E., SCHNEIDER, WALTER A., VAN DER MERWE, CAREL W., WAHLERT, HOWARD E. *Physical Science*. New York: The Macmillan Company, 1942. 639 p. $3.90.

In the words of the authors, "The main purposes of this book are to provide a broad background of knowledge of the physical sciences which is essential to the culture of the educated man, . . . to provide some understanding of the scientific method . . ." The basic concepts are selected from the fields of astronomy, chemistry, geology and physics. The book aims to foster an appreciation of science in our civilization. There is good balance of material from the different science fields treated; Mathematics is used freely. Many significant diagrams are helpful. Photographic illustrations are few in number. On the whole explanations are exceptionally clear and it seems like a very usable text.

—W.G.W.

RENNER, GEORGE T. *Conservation of National Resources*. New York: John Wiley and Sons, Inc., 1942. 228 p. $2.75.

American people are finally becoming conscious of the fact that the problem of conservation is really serious. The education and voluntary contribution of all will be necessary in the solution of this important problem.

This book is planned primarily to be used as a basic textbook for students in teachers' colleges who are studying conservation. It would also serve as an excellent reference book for high school classes.

Part I, "Facts, Ideas, and Objectives," reviews the evidences of resource destruction over the United States, analyses the fundamental process of resource use, and examines the nature, scope, and development of the conservation idea. Part II, "Outline of Resources, Problems, and Proposals", presents the major problems in our use of each of the principal classes of resources, together with proposed remedial treatments. Part III, "Curriculum, Methods, and Materials", seeks to sort and evaluate the materials and information available to the teacher and pupil. Photographs, graphs, and maps are used in illustrating the book. At the end of each chapter controversial questions are given.

—Roy V. Maneval.

HYMAN, LIBBIE H. *Comparative Vertebrate Anatomy*. Chicago: The University of Chicago Press, 1942. 544 p. $3.50.

This is the second edition of the well-known *Laboratory Manual* by the same author. For twenty years Miss Hyman's manual has been the standard manual in college laboratories. With this edition it appears in textbook form. The fact that this is only the second edition speaks well of the genuine worth of the first edition. Miss Hyman is research associate, American Museum of Natural History, and one of the country's most distinguished zoologists.

—Greta Oppe.

HEGNER, ROBERT W. *College Zoology*. New York: The Macmillan Company, 1942. 817 p. $3.75.

It is with deep regret that the reviewer lists this fifth edition of *College Zoology* as the work of the late professor of protozoology in the school of hygiene and public health of the Johns Hopkins University. Dr. Hegner died March, 1942.

Dr. Hegner did not alter his original plan in this new edition, but he made many changes in the text to meet the progress made in the zoological science during the past six years. The glossary has been enlarged and a complete index is provided so that a reader can easily find the data he desires. The most noteworthy change in the illustrations is the inclusion of eight colored plates by R. Bruce Horsfall making the book an unusually attractive edition. These illustrations

are used, however, to emphasize the fact that most animals are colored and to show various phenomena of color that cannot be illustrated in any other way. —Greta Oppe.

ETHEREDGE, MAUDE LEE. *Health Facts for College Students.* Philadelphia: W. B. Saunders Company, 1942. 379 p. $2.25.

This is the fourth edition of a most readable book, aimed at helping the student derive the utmost in personal development—both physical and mental. Nutrition, proper diet, fuel requirements, vitamins, common illnesses, immunity, venereal diseases, and community health, are among several problems discussed. Social and present emergency aspects of health are emphasized throughout the book. —C.M.P.

COMSTOCK, JOHN P. *Introduction to Naval Architecture.* New York: Simmons-Boardman Publishing Company, 1942. 209 p. $4.00.

Many individuals, especially those in naval service or contemplating going into such service, will find this book on naval architecture helpful and educative. It is suitable reading for high school graduates who have not had college mathematics.

The author has had much practical experience and is now Assistant Naval Architect for the Newport News Shipbuilding and Dry Dock Company. In Part I, each subject is applied to an "example" ship, with numerous problems to be worked out by the student. In Part II the design of a "problem" ship is carried through the design stages. —C.M.P.

SMILEY, DEAN FRANKLIN, AND GOULD, ADRIAN GORDON. *Manual of War-Time Hygiene.* New York: The Macmillan Company, 1942. 86 p. $1.00.

This important pamphlet provides a brief summary and bibliography of those materials which a college student and other interested persons may consider to improve their own personal hygiene. Personal hygiene is most important now in the all-out war effort. This is a practical and readable treatise. Service and prospective service enlistees, leaders, and workers in civilian defense and first-aid, science health, and physical education teachers will find this one of the finest pamphlets of its kind.

Chapter I discusses military hygiene, Chapter II, civilian defense, and Chapter III, war-time first-aid. There is an excellent bibliography. —C.M.P.

SCIENCE REFERENCE BOOKS

NICE, MARGARET MORSE. *The Watcher of the Nest.* New York: The Macmillan Company, 1939. 159 p. $2.00.

This is a delightful account of the intimate activities of song sparrows that lived in the author's garden and in the territory between her home near Columbus, Ohio, and the Olentangy River. This tract of about sixty acres of land was an ideal situation for studying birds unobserved by them. It contained tall cottonwood, sycamore, elm, and hackberry trees; dense patches of elders; and tangles of briers, giant ragweeds, nettles, burdock, cow parsnip, and other weeds. In this bird haven, Mrs. Nice consistently and assiduously observed song sparrows over a period of eight years. She kept accurate records of their territorial claims, their quarrels over boundary rights, their songs, their mating and nesting habits, their activities concerned with rearing young, and their ways of communicating with each other. She banded many birds which enabled her to study variations in behavior of individuals over a period of time. The vivid picture of the life of song sparrows and of a few other birds that lived in the same area fills the reader with an intense desire to go into the fields to enjoy song sparrows at first hand and stimulates him to be more observant of birds that visit his own backyard.

The book is beautifully illustrated in black and white by Roger T. Peterson, Art Editor of *Bird Lore.* It is a valuable contribution to bird literature and will be appreciated by students of ornithology. It should find a place in home, school, and public libraries. —F.G.B.

KRAUS, RENÉ. *Europe in Revolt.* New York: The Macmillan Company, 1942. 563 p. $3.50.

Europe in Revolt is one of the most challenging war books that has yet appeared. It is a story of almost unbelievable brutality and barbarity. The story of German frightfulness is vividly, graphically portrayed. In no other war of modern or medieval times has a nation reached the depths of depravity practiced by the dreaded Gestapo. Some day the pent-up fury of the subjected peoples will rise like a dreaded plague to scourge the German people. Even now Europe is seething in revolt and carrying out an underground war of attrition. No conquered European nation accepts the New German Order as the German radio propagandists would have one believe.

The wiping out of Lidice from the face of the earth as a punitive measure has only served to make Lidice immortal. The new Lidice, Illinois, will ever serve as a reminder of German degradation. The ten thousand Czechs put to death to avenge the death of the hangman Heydrich will plague the German people as a ghost. And as Kraus points out in this book, we should not longer fool ourselves that this cruel barbarity practiced on all Jews, on the Poles, the Czechs, and the Greeks is the policy and sanction of only a few German leaders, but rather that the Ger-

man masses must be held equally responsible and guilty. Surely no other nation has ever so carefully, brutally, scientifically planned the persecution and the extermination of other peoples as have the Germans. The question may well be raised,—Would our fate be similar to that of the other conquered nations? There is no reason to believe it would not, and there is every reason to believe that it would. Surely every reader of this book will want to personally see that this does not happen to us. And when one finishes reading the book, one wonders what justice should or can really be meted out to the German people when they finally get their deserts.

—C.M.P.

ENGLEMAN, F. E., SALMON, JULIA, AND MCKENNY, WILMA. *Scales and Fins.* New York: D. C. Heath and Company, 1938. 293 p. $0.96.

This is a book about fish and various common methods of fishing for children from ten to twelve years of age. It is the story of the experiences of a boy who has had opportunity to fish in rivers, streams, lakes, and oceans. With his parents, he visits great fish markets, fish hatcheries, and fishing centers that are famous for mackerel, cod, tuna, herring, oysters, crabs, and seals.

This informal discussion of fish and various types of fishing is interesting and valuable supplementary reading material for science and social study classes in elementary schools.

—F.G.B.

JOHNSON, GAYLORD. *How Father Time Changes the Animals' Shapes.* New York: Julian Messner, Inc., 1939. 183 p. $2.00.

The author's purpose in writing this book is "to give the young reader a simple narrative which includes the great moving picture of change as it is broadly agreed upon and which will make reading a living experience". In this amazing story, the author takes the reader back millions of years. As centuries pass, one sees the elephant gradually developing a trunk; the camel developing a long neck; birds developing from lizards; the foot of the horse changing in such a way that the present-day horse walks on one toe; and some animals, such as the great dinasours and North American elephant, dying out. One also sees great changes taking place in the surface of the earth.

The story is told in a simple vivid manner. No difficult scientific words are used. It is beautifully and abundantly illustrated by photographs and drawings in black and white.

—F.G.B.

MORGAN, WILLARD D., AND LESTER, HENRY M. *Graphic Graflex Photography.* New York: Morgan and Lester, Publishers, 1940. 424 p. $4.00.

This is a master book for the larger cameras, such as the Graflex and the Speed Graphic. Twenty photographic experts have contributed to various aspects to make this a most comprehensive, practical, authentic treatise for users of all cameras. Altogether the book is an excellent source of information to all interested in photography whether because of their use of cameras or because they enjoy good photographs and desire to know more of the hows and whys of photography. The numerous excellent photographs add much to the interest and appeal of the book. Science teachers and science club sponsors will find it an excellent reference.

In addition to the thorough treatment of the usual aspects of photography, there are chapters on such aspects as illumination and its control, documentary reproduction, aerial photography, news and press photography, how to use the view camera, illustrative and advertising photography, science photography, publicity photography, and so on.

—C.M.P.

HEXTER, PAUL LOUIS. *Make Your Pictures Sing.* San Francisco: Camera Craft Publishing Company, 1940. 188 p. $3.00.

This is a book on methods of perfecting photographic technique. It attempts to clear away the confusions and prejudices that stand in the way of the photographer's making the camera do his own will, for the camera can make many different records of the same scene. Too often the photographer becomes enmeshed in technical details and forgets the most important purpose of photography — making pictures that live. Many useful suggestions to make pictures sing are included in this different treatise, valuable to both beginners and advanced students.

—C.M.P.

MORTENSEN, WILLIAM. *The New Projection Control.* San Francisco: Camera Craft Publishing Company, 1942. 123 p. $2.75.

This is the fourth version of an article first appearing in 1933 and later expanded to appear in book form. Everyday applications of projection control to ordinary and landscape photography are emphasized. Many illustrations are used to enhance the textual material. Suggestions are quite specific and practical.

Chapter headings are as follows: (1) "Picture taking and picture making," (2) "Equipment and materials," (3) "Negative quality," (4) "Basic projection printing," (5) "Local printing," (6) "Distortion," (7) "Combination printing," and (8) 'It's up to you."

—C.M.P.

HOLME, C. G. *Modern Photography.* New York: The Studio Publications, Inc., 1942. 119 p. $3.50.

This is the twelfth appearance of *Modern Photography*, and the present issue, like its predecessors, contains a superb and widely-chosen collection of approximately 140 photographs in black-and-white, in color and in monochrone. To a large degree the photographs

reflect the happenings of the last twelve months. Included are still-life, life, action, portraits, news-shots, *etcetra*—a panorama of the American scene. There is an excellent article by Lancelot Vining entitled "What of the Future?"

—C.M.P.

FRAPIE, FRANK R., AND JORDON, FRANKLIN I. *The American Annual of Photography, 1943.* Boston: American Photographic Publishing Company, 1942. 240 p. $1.50.

This is the forty-seventh American Annual of Photography. And the numerous photographs and the many splendid articles by outstanding photographers is on a par with the other splendid Annuals in the long series. This annual has become the American photographers' handbook. There are 77 photographs followed by explanatory and technical data. Among the many excellent articles are: (1) "Space-Time and the Photographer", (2) "Cameras, Color and Kodachrome", (3) "Euipment in Theory and Practice", (4) "Nature in Sequence", (5) "Infrared Pictorialism", (6) 'Lighting for Color Portraiture", (7) "Efficient Light Sources in Photomicrography", (8) "Artificiality and Convention", (9) "Technique in Documentary Photography", and (10) "Photoflash". —C.M.P.

MALONEY, T. J. *U. S. Camera, 1942.* New York: Duell, Sloan and Pearce, 1942. 252 p. $3.85.

This seventh U. S. Camera Annual has two hundred black-and-white and color photographs which were selected from over 21,000 black-and-white and color photographs submitted. Thus the Annual is an anthology of America's best photography, both amateur and professional.

The book is divided into five sections: (1) Work of Photographers from other countries, (2) Best news photographs of 1941, (3) Photographic posters appealing for support of America's defense program through purchase of defense bonds, (4) Review of year's outstanding motion pictures, and (5) A complete article on amateur motion pictures. —C.M.P.

BROWNELL, L. W. *Natural History With a Camera.* Boston: American Photographic Publishing Company, 1942. 292 p. $3.75.

Natural History With a Camera should arouse enthusiasm in two large groups of readers: those interested in nature and the out-of-doors, and the amateur photographers. Surely Brownell amply demonstrates here that nature photography is fascinating both to photographers and to amateur scientists. All of the numerous, interesting photographs (287 in number) were made by the author, usually in the natural setting, without the use of elaborate or special equipment. The descriptive content of the book is most readable and interesting.

The first chapter is devoted to a discussion of photographic equipment; then follows twelve chapters, one devoted to each of the twelve months of the year.

In a world having its chief interest centered in fighting a global war, this publication comes as a most welcome relief. Surely here is one of the best popular science and photography books yet published. It is to be recommended as an unusually fine book for the high school science library, for the science teacher, and the lay reader. The reviewer has thoroughly enjoyed reading it, as will many others, both old and young.

—C.M.P.

HYLANDER, C. J. *Out of Doors in Spring.* New York: The Macmillan Company, 1942. 143 p. $1.50.

This is the first of four books describing the out of doors in each of the four seasons. The author, who has written several science books, has illustrated the book with many of his drawings.

The chapter titles give a good description of the contents of the book. They are: The Trees Awaken, Life Stirs in the Ponds, Animals of Land and Water, The Flower Parade Begins, Mosses and Ferns, Crawlers Become Fliers, and Our Songbirds Return from the South. This book would be excellent reference material for either elementary or junior high school. It would make a vauable addition to any home library.

—Roy V. Maneval.

ROBINSON, W. W., AND IRENE. *At the Seashore.* New York: The Macmillan Company, 1942. 38 p. $2.00.

A very attractively illustrated story of the experiences of a boy and a girl and their cocker spaniel at the shore. Although apparently describing the Pacific Coast it is sufficiently general to fit in with any seashore experience.

—O. E. Underhill.

MELLEN, IDA M. *Twenty Little Fishes.* New York: Julian Messner, Inc., 1942. 53 p. $2.00.

The author, former chief Aquarist of the New York aquarium, interestingly describes and tells about the behavior of some half-dozen fishes seen in "the big aquarium", four common to fresh water ponds, six of interest to home aquarium fans, and four common to the shallows of the sea shore. Illustrated by Else Bostelmann who is well known for her marine drawings, the book is a Junior Literary Guild selection for ages seven and up. —O. E. Underhill.

BEARD, DANIEL. *Fading Trails.* New York: The Macmillan Company, 1942. 229 p. $3.00.

This book prepared by the U. S. Dept. of the Interior, National Park Service, Fish and Wildlife Service, is the dramatic story of American wildlife from its discovery and exploitation down to its present status of restoration. Here are the

exciting stories of birds and mammals, fish and reptiles—swarms of creatures which no longer crowd our skies or crowd our land and many others on their way down the "fading trail," save for the efforts of naturalists who have sought to restore an abundance of wildlife to America. Here is the sort of book on conservation every American should read, for it is a ringing challenge to every American to lend a hand.

In order to enhance the value of the book for use with a wildlife conservation program, the authors have divided the contents into zoo-geographical regions. This delightful book is illustrated with full color plates, halftones, and line drawings. —Greta Oppe.

MORGAN, ALFRED. *Getting Acquainted with Electricity.* New York: D. Appleton, Century Company, Inc., 1942. 346 p. $3.00.

Alfred Morgan, as a writer of popular science books, has produced some of the best in the field. In this one he explains how electricity works and what it can accomplish. Throughout the book he succeeds in treating the subject of electricity in a simple, non-technical manner. It is written especially for the homeowner who is confronted by many problems in the use of electricity. It would also prove to be an excellent reference for high school physics classes.

This book is amply illustrated with drawings by the author. All the fundamentals of electricity are covered by discussions of such subjects as static electricity, magnetism, electric cells, electromagnetism, electrical measurement, electromagnetic induction, alternating currents, production of heat and light from electricity, induction coils, radio communication, and electrochemistry.

—Roy V. Maneval.

HAYNES, WILLIAM. *The Stone That Burns.* New York: D. Van Nostrand Company, Inc., 1942. 345 p. $3.75.

Here is a capital story of the development of the sulfur industry in America. In this newly-published book, William Haynes, author of *This Chemical Age* and other books on chemical industry, relates the colorful story of Herman Frasch and those sturdy pioneers, or "brimstone veterans," responsible for the production of the first Gulf Coast sulfur.

Haynes got the idea for his story on a visit to Grande Ecaille and other mines where he heard the fascinating stories of American courage and engineering skill. It is more than a chronological history of the sulfur industry in Texas and Louisiana and the markets of the world; it is a story of men, smart traders in mineral rights, rugged financiers, and resourceful engineers at a time when everyone who expressed an opinion seemed convinced that the Frasch process of mining sulfur could not be done and when one prominent man offered to "eat every ounce of sulfur Frasch pumped." The book contains many pictures of the sulfur industry not only in our country but in Sicily, Java, Japan, and the Dutch East Indies.

There is a fine statistical appendix giving the properties of sulfur, U. S. consumption of sulfur in comparison with other commodities, German supplies, world production today, analyses of pyrites and production of sulfuric acid since 1865.

—Greta Oppe.

HUMBY, S. R., AND JAMES, E. J. F. *Science and Education.* Cambridge: at the University Press; New York: The Macmillan Company, 1942. 143 p. $1.25.

Chapter I is a powerful description of the effect of science and technology on our social institutions, and a presentation of the extent to which these institutions are unaware of this effect upon them. Thus they fail to avail themselves of the potentialities offered by science and the scientific method for aiding in the solution of pressing social problems. The remedy is seen in giving, through the schools, a knowledge and appreciation of the part science can and should play in our ways of living. The analysis of science teaching in the schools of England which follows shows many parallels to conditions in the United States. Comment as to proper course content, principles for building a curriculum, and the like, will have a familiar ring to those who have followed developments in this country. This small volume says a great deal in its small space and deserves thoughtful reading by teachers of science. —O. E. Underhill.

KORZYBSKI, ALFRED. *Science and Sanity.* Lancaster, Pa.: The Science Press Printing Company, 1941. 761 p. $6.00.

Much interest has been shown recently in the new science of semantics in colleges and even in high schools. Mr. Korzybski may be considered as the initiating stimulus to this movement beginning about 1935 with his First American Congress on General Semantics. While not an easy book to read *Science and Sanity* is extremely thought provoking and may prove to be one of the very significant books of this generation. The author advises several times in the first fifty pages or so that the book cannot be read easily and lightly with profit, and that it should be read at least three times. The reviewer agrees with this. Because of its revolutionary character and because of the extreme conciseness of its language (in spite of over 750 pages) a summary of its point of view cannot be given in a brief review. It will reveal to the teachers of mathematics and science, however, a vastly greater and more important realm for his work than is usually seen in these subjects. Mathematics and science teachers should certainly read Part VIII, pp. 571–761, which gives a "semantic survey" of the fields of mathematics and physics.

—O. E. Underhill.

HOLMES, MAURICE C. *An Outline of Probability and its Uses.* Minneapolis, Minnesota: Burgess Publishing Company. 119 p. $1.50.

This book with its illustrative and unsolved problems, as well as tables and formulas and a comprehensive bibliography is a handy working manual for those desiring a comprehensive knowledge of probability as a tool in science and engineering and the statistical studies in the industrial laboratories of today. It offers biology a highly refined method for analyzing observations; in physics, it forms the basis of the kinetic theory of gases; and as for engineering uses, it is especially helpful in studying annual rainfall data, flood records, capacities of sewers, design of spillways for dams, and telephone trunking problems and the like. —Greta Oppe.

OGILVIE, MARDEL. *Terminology and Definitions of Speech Defects.* New York: Bureau of Publications, Teachers' College, Columbia University, 1942. 312 p. $3.25.

This contribution seeks to lay the ground work for a clarification and systematization of terms used in correcting speech defects by specialists. Thousands of definitions were collected by Dr. Ogilvie and summarized with positive recommendations. The appendix is replete with tables and outlines and a helpful index as how to use them and an excellent bibliography on speech defects. Such knowledge will prove valuable to workers and research specialists in the field of speech and tend to lessen the confusion now existing among specialists because of the lack of a systematic terminology. —Greta Oppe.

WILSON, NETTA W., AND WEISMAN, S. A. *Modern Medicine.* New York: George W. Stewart Publisher, Inc., 1942. 218 p. $2.00.

Modern Medicine is the sort of book that brings authoritative information to the layman in a style that will catch his interest but in a manner that will give him the more important aspects of medical discoveries without taxing his scientific ability. Great discoveries and cures are here, together with the great personalities behind the more recent developments in medical theory and practice. There are fifteen chapters in the book dealing with a look into the past and a forward look into the future. Within these pages one finds the story of bacteria, animal parasites, virus diseases, vaccines and serums; diseases of the blood, tuberculosis, cancer, and heart disturbances are discussed; the story of surgery and anesthesia, endocrine glands, and nutrition; all these are cleverly written about under such titles as "Microbe Murderers," "Great Fleas Have Little Fleas," "Guinea Pig Heroes," "Valentines, Valves, and Ventricles," "Life-saving Knives and Needles," "Circus Freaks and Ordinary People."

The book closes with a list of some of the books about medicine and medical science that have been written for the general reader. Especially fine is the group listed for young men and women who want careers in medicine or medical occupations. —Greta Oppe.

CRAINE, HENRY C. *Teaching Athletic Skills in Physical Education.* New York: Inor Publishing Company, 1942. 236 p. $2.75.

This would seem to be a timely book filling an urgent need. Not only will all physical education teachers find much useful information here, but each active participant in the several sports described will find here some practical suggestions which, if put into practice, would result in self-improvement.

The first seven chapters present the modern philosophy of physical education, and explain and solve the problems that confront the instructor in developing a program of teaching athletic skills. Two hundred fifteen athletic skills, games, and activities are presented. There are chapters on soccer, basketball, volleyball, track and field, and tennis. —C.M.P.

STRAIN, FRANCES BRUCE. *Sex Guidance in Family Life Education.* New York: The Macmillan Company, 1942. 430 p. $2.25.

This book is intended for a guide to sex education in the schools. It offers a long range program progressively through all grades from primary to junior and senior high school. Chapter headings are as follows: (1) "A New Ideology", (2) "Gaining Community Support", (3) "Matters of Organization", (4) "First School Experience", (5) "The Family Frame-work", (6) "The Pre-adolescent in Action", (7) "The Creative and Recreative Pursuits", (8) "The Transitional Period", (9) "Family Relationships", (10) "Technique in Sex Teaching", (11) "The Counselling Center", and (12) "Personal and Academic Qualifications". The book has a most readable literary style, seems to take an altogether practical viewpoint. Many concrete illustrations are used. —C.M.P.

GUERRERO, ANTONIO PEROL. *New Technical and Commercial Dictionary.* Brooklyn: Chemical Publishing Company, 1942. 600 p. $10.00.

This would seem to be not only an excellent dictionary, but also a fine reference. Part I is Spanish-English; Part II is English-Spanish and Part III contains conversion tables of weights, measures, and monetary units. With the increased emphasis upon the study of Spanish, this dictionary, emphasizing as it does science, military, and commerce, is especially timely. —C.M.P.

ATKINSON, CARROLL. *Radio in State and Territorial Educational Departments.* Boston: Meador Publishing Company, 1942. 136 p. $1.50.

This is the seventh title in a series of books on radio in education. This book is organized primarily as a source book recording successes and failures of all fifty-seven of the state and

territorial educational departments. Contents are divided into two sections: (1) "Broadcasting as an Instructional Tool", and (2) "Broadcasting as a Public Relations Tool". —C.M.P.

ATKINSON, CARROLL. *Broadcasting to the Classroom by Universities and Colleges.* Boston: Meador Publishing Company, 1942. 128 p. $1.50.

In this book Atkinson has recorded the history development of the broadcasting of radio programs intended specifically for classroom use by thirty-eight universities and colleges. The University of Wisconsin has had an extensive statewide plan in operation since 1931. —C.M.P.

ATKINSON, CARROLL. *Radio Programs Intended for Classroom Use.* Boston: Meador Publishing Company, 1942. 128 p. $1.50.

The author is recognized as the American authority on the history of radio used as an educational tool. Here he briefly sums up and evaluates the findings of three preceding volumes, then records in greater detail the attempts to broadcast programs for classroom use. Undoubtedly radio has great possibilities for classroom usage. Up to now the programs and the usage made of the programs have been more or less in a haphazard state. —C.M.P.

SYMPOSIUM. *In-Service Growth of School Personnel.* Washington: Department of Elementary School Principals of the National Education Association, 1942. 576 p. $2.00.

This is the *Twenty-first Yearbook* of the Department of Elementary School Principals. In recent years the in-service growth of teaching personnel has been one of the major problems in education. Hence this yearbook is especially timely and useful. Articles have been contributed by numerous writers. Surely all teachers and administrators would greatly profit by reading this book.

Individual chapter headings are as follows: (1) "Fundamentals of In-Service Improvement," (2) "Citywide Cooperative Effort," (3) "Cooperative Effort Within a School," (4) "Regional Programs for Staff Improvement," (5) "In-Service Growth Through Community Contacts," (6) "Specific Supervisory Efforts," (7) "Administrative Policies and Practices," (8) "Personal and Professional Activities," and (9) "Evaluation of the In-Service Program." —C.M.P.

ROEBUCK, JOHN R., AND STAEHLE, HENRY C. *Photography: Its Service and Practice.* D. Appleton-Century Company, 1942. 283 p.

This book is an overview of photography as it has been developed and as it is practiced today. The brief historical sketch of photography is basic to the consideration of photographic materials and equipment. Both the theory and the practical phases of the subject are presented. With emphasis on the science of photography, the content should meet a real need for the experienced amateur and the advanced student in courses of photography.

Since it does not offer much help for the beginner with his first camera it will serve as a text in technical schools, and photographic courses for teachers in schools of education. The laboratory manual which is a part of this volume offers suggestion for a laboratory course and a method of procedure.

The bibliography allows the students to explore certain areas and to read original source materials. —E. C. Persing.

MILLER, CARL W. *Principles of Photographic Reproduction.* New York: Macmillan Company, 1942. 353 p.

There is a growing appreciation of the possibilities for recording and interpreting the activities in the world about us. To do this will require a knowledge of the fundamental principles which are presented in this book. These principles are treated in connection with much more recent developments as the use of the small camera, color and photographic procedures. Part One, "Drawing", deals with lenses and their uses. Part Two, "Gradations", treats such topics as, Exposure, Development, Prints, Special Processes, Transparencies and Sterescopy. Part Three, "Color", is a good summary of the processes and development of color photography to-date.

The problems which are a part of the Appendix should be suggestive and helpful teaching devices.

This book is obviously for technical schools, teachers' courses in photography and the more advanced worker. —E. C. Persing.